SIPHONAPTERA

FROM CENTRAL AMERICA AND MEXICO

A MORPHOLOGICAL STUDY OF THE AEDEAGUS WITH DESCRIPTIONS OF NEW GENERA AND SPECIES

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PREFACE

To Dr. W. P. Hayes, Professor of Entomology of the University of Illinois, I am indebted for his inspiration, his helpful criticisms, and his stress on a knowledge and use of morphology as a foundation for systematics. Dr. W. V. Balduf of the same institution was very helpful in aiding with taxonomic problems encountered early in this study.

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ROBERT TRAUB

CONTENTS

PART II

PART III

LIST OF ILLUSTRATIONS

INTRODUCTION

Within the last several years there has been a rapidly growing interest in the study of fleas. This has been due, in part, to the importance of these insects in the epidemiology of plague and other diseases; but it has also been the result of a growing realization of the fascinating biological and taxonomic problems that are to be found in the study of ectoparasitic arthropods. Of these, few insect groups present more interesting problems regarding affinities and host relationships than do the fleas.

To date, most research on fleas has had to be concerned with systematics, and international authorities such as Dr. Karl Jordan have spent a large part of their time in laying the foundations of flea taxonomy. Still, there are many gaps in our knowledge of the systematics of fleas. The flea fauna of certain large geographic areas of the world is virtually unknown. Among other reasons, this is partly because of the fact that their fauna has not been investigated and partly because fleas are not easy to collect. The present study furnishes a striking example of how little is known about the fleas of such areas. There have been relatively few species reported from Central America and Mexico, yet twenty-five new species and subspecies and two new genera from this region are described below. There are also many lacunae in our knowledge of the fleas even of well-collected areas; these gaps may be due in part to the extinction of intermediate forms along with their hosts during the geologic history of mammals.

Despite the many contributions that have broadened our understanding of the order, there are certain aspects of Siphonapterology that have received relatively little attention: for example, bionomics, comparative morphology of the larvae, and comparative studies of the aedeagus to assess its taxonomic value. This neglect is to be expected, in view of the relatively recent development of flea taxonomy, for it has been repeatedly shown that systematics is a necessary prerequisite to such studies.

The purpose of the present study is two-fold: to provide an introduction to the fleas of Central America and Mexico, and, in so doing, to demonstrate the taxonomic importance of the aedeagus in the classification both of species and of higher categories.

In Part I of this paper new genera and species are described and two genera are revised. The aedeagus is described for each new species, and characters are noted that are considered to possess generic and specific value; these characters are utilized in the revisions. A new genus from Mexico is shown to be related to several North American genera, each of which has, in the past, been placed

in a different family or subfamily. The structure of the aedeagus is cited as evidence of the relationships of these genera.

Additional material makes it possible not only to describe the aedeagus of the new forms and related species, but to include also (in Part II) a comparative study of the aedeagus of each of twenty-six genera (representing five families) from Central America and Mexico. Three genera that have been reported from the region are not treated here because of lack of material. In all, the aedeagi of fifty-two species and subspecies are figured. Subfamily and family characters are discussed, and, on the basis of aedeagal characters, changes in the family assignment of two genera are proposed.

Snodgrass (1946), in his excellent morphological study of the intromittent apparatus of nine genera of fleas, states that his study "probably will show the principal types of structural modifications . . . in the . . . order, but only a more intensified study will determine what value the genital characters may have for taxonomic purposes." It is hoped that the present paper will demonstrate this value. A glance at the last few plates will aid in visualizing the type of aedeagal characters described.

Unfortunately it is impractical to prepare a monograph of the fleas of Central America and Mexico at the present time. Such a "monograph" would be woefully out of date by the time of publication. Probably not more than half of the genera that occur in the region are yet reported; eleven are here recorded for the first time. The same situation holds for the species. While I was parasitologist of the Fourth Hoogstraal Biological Expedition to Mexico in 1941, I collected ten new species and two others previously known from only one sex, in one relatively small area, the vicinity of Tancítaro, Michoacán.

PART I

DESCRIPTIONS OF NEW GENERA AND SPECIES

As stated in the introduction, this section consists of descriptions of new genera and species and revisions of certain important genera of fleas from Central America and Mexico. I have tried, by means of these descriptions and revisions, to evaluate the taxonomic characters of the aedeagus and, in so doing, to develop a concept of specific and generic aedeagal characters for the Order. It will readily be seen that certain of these characters serve to separate species easily; examples of such characters are the shape of the crochets and lateral lobes, the modifications of the median dorsal lobe, and the structure of the armature of the inner tube. On the other hand, the position of the crochets, the type of median dorsal lobe, and the presence of accessory sclerites seem to constitute valid generic characters. The aedeagal characters are again discussed at the generic and family level in Part II of the paper. The terminology of the aedeagus that is used herein is based, in the main, on the studies made by Snodgrass (1946).

It should be noted that the material studied demonstrates that the fleas of the higher altitudes of Mexico and Central America apparently exhibit a closer relationship with those of North America than with those of South America. *Polygenis* Jordan and *Rhopalopsyllus* Baker are typically South American, but the other genera discussed are fundamentally North American in their affinities. *Pleochaetis* Jordan extends into South America as well as the United States, but reaches its greatest development in Mexico and Central America.

Because the *Pleochaetis* complex of genera (including *Jellisonia* Traub) is so characteristic of the region, it is discussed first. Descriptions of new species of other ceratophyllid genera follow. The family Hystrichopsyllidae, here represented by three genera, is treated next, and the description of a new *Pulex* (family Pulicidae) concludes this part.

All measurements of tibiae and tarsi (petiolate base excluded) are in microns.

Family CERATOPHYLLIDAE

REVISION OF THE GENUS *JELLISONIA* TRAUB

Fleas of the genus *Jellisonia* Traub 1944 are apparently widely distributed on rodents in the southwestern United States and Mexico. Two species were discovered in the course of investigations on Bullis fever and murine typhus in Texas. A discussion of the genus is pertinent because of the existence in collec-

tions of several undescribed species and new records, and because of the varied nomenclature in the literature. A review of the fleas of this genus also demonstrates the excellent taxonomic characters to be found in the aedeagus.

The following descriptions were made from specimens mounted in balsam or from specimens that were remounted after partial extrusion of the aedeagus had been accomplished by means of sharp needles.

Genus **JELLISONIA** Traub

Jellisonia Traub, Field Mus. Nat. Hist., Zool. Ser., **29**, (15), p. 211, 1944.

Pleochaetoides Augustson, Jour. Parasit., **30**, (6), p. 366, 1944 (Jan., 1945). New synonymy.

Genotype: *Jellisonia klotsi* Traub 1944.

The genus *Jellisonia* superficially resembles *Pleochaetis* Jordan 1933 but is readily separated by the presence of the stout bristle on the distal arm of the ninth sternum, the micro-mucronate crochets, the very well-developed armature of the sheath of the inner lobe of the aedeagus, the tibial comb, the arched spermatheca, and the absence of the dorsal bristle of the anal stylet.

Frontal tubercle distinct. Head regions each with three rows of bristles. Eye well pigmented. Genal ctenidium absent. Pedicel of antenna with bristles shorter than clavus. Labial palpi not extending beyond apex of procoxae. Prothoracic ctenidium of about 16 or 18 spines. Profemora each with about five small lateral bristles. Meso- and metacoxae without small mesal bristles on proximal half. At least some of dorso-lateral bristles of protibiae, and usually of mesotibiae, from near middle to apex short and subequal in size, forming a comb, suggesting *Peromyscopsylla* I. Fox, or *Amphipsylla* Wagner. Distal segment of tarsi with most proximal of plantar bristles somewhat displaced ventrad. First four or five abdominal terga with apical spinelets. Typical abdominal terga with two rows of bristles. Only one antepygidial bristle in male, three in female. Males with a stout cephalad-directed bristle or spiniform on distal arm of ninth sternum. Two acetabular bristles present. Angle of male ninth sternum with rod or spring.

Aedeagus with well-developed subovate lateral lobes enclosing most of end chamber; with a conspicuous acute median dorsal lobe; with crochets apically rugged, micro-tuberculate. Intersegmental membrane between male eighth and ninth segments expanded. The X-gland of Wagner apparently lacking. Male eighth sternum reduced to a narrow membranous flap, often without bristles. Anal stylet of female elongate, with dorsal bristle lacking. Head of spermatheca strongly convex above, with dorsal and ventral margins subparallel.

Jellisonia klotsi Traub. Plates 1, 2.

Jellisonia klotsi Traub, Field Mus. Nat. Hist., Zool. Ser., **29**, p. 212, 1944.

Male and Female: Head (pl. 1, fig. 1, male).—Fronto-clypeal region with margin evenly rounded, finely granular; frontal tubercle median and distinct. Preantennal region with three rows of bristles; first row of eight or nine small bristles, somewhat irregularly arranged; middle row of four well-developed bristles; ocular row of three large bristles, the largest cephalad and dorsad of the eye. A series of about four very small bristles bordering the antennal groove cephalad and dorsad of the conspicuous well-developed subovate eye. Genal process fairly broad, becoming acuminate. A bristle present at ventral angle of clypeus, between the small labrum and the well-developed four-segmented maxillary palpus.

Epipharyngeal stiletto (*EPX.*) arising between maxillary palpi, somewhat dilated apically. Maxillary lobe (*MX.*) an acute triangle, extending almost to apex of fourth segment of labial palpi (*L.P.*), which in turn extend about three-fourths of the length of the procoxae. Maxillary laciniae (*LAC.*) (mandibles of authors) lightly sclerotized, with subapical micro-serrations. Bristles on scape of antenna subequal to or shorter than scape. A row of very small bristles bordering dorsal margin of antennal fossa. Postantennal region with three rows of bristles arranged 4–5–5, the most caudal the longest; small hairs intercalated between some of the large bristles.

Thorax.—With fine bristles preceding the nine pronotal ctenidial spines on each side; a few small hairs intercalated between some of the bristles. Meso- and metanota with two rows of bristles, the most caudal the longest, preceded by a few small hairs. Mesonotum with three seta-like extensions, suggesting thin elongate spinelets. Mesepisternum (*MPS.*) with three bristles, one very small. Usually with seven bristles on mesepimeron (*MPM.*) but sometimes with eight, because of displacement of the most caudal mesepisternal bristle or because of an accessory small bristle near the spiracle. Metanotal flange with an apical spinelet. Lateral metanotal area of metathorax well developed, quadrate, with two bristles near the caudal margin. Metepisternum with one bristle in dorso-caudal angle. Metepimeron with nine bristles in two irregular rows of four, plus one bristle at dorso-caudal angle.

Legs.—Meso- and metacoxae with a submedian lateral longitudinal sclerotization, and a mesal somewhat trident-shaped longitudinal sclerotization, the caudal arm of the trident reduced to a spur joining the lateral sclerotization medially and with the caudal branch of the trident proximally joining the lateral sclerotization. Profemora with about ten small thin lateral bristles; meso- and metafemora with one each. Tibial comb (pl. 1, fig. 2) formed by a row of about eight short and subequal dorso-lateral bristles. Proportionate measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	163	67	67	54	38	80
Meso-	288	160	115	70	47	90
Meta-	390	256	176	112	64	102

None of tarsal bristles reaching beyond apex of following segment; apical bristles of third segment of metatarsus subequal to fourth segment. Distal tarsal segment of each leg with four pairs of lateral plantar bristles and a somewhat displaced median basal pair. Blade of unguis somewhat over twice the length of the thickened recurved basal portion.

Abdomen.—First tergum with three rows of bristles, the first row very incomplete. Male with one or two apical teeth on first tergum; second and third terga with two teeth on each side, the fourth with one. Female with tergal teeth 1–2–2–1. Caudal row of bristles on abdominal segments two to six much larger than those of cephalic row and extending ventrad to spiracles. One bristle on each side of basal sternum. Male sterna three to six with two bristles. Female with these bristles 3–2(3)–2–2. Male with middle antepygidial bristle (pl. 1, fig. 3, *A.B.*) well developed, others vestigial. Female with three antepygidial bristles (pl. 2, fig. 6); middle one twice the length of the others.

Modified Abdominal Segments: Male (pl. 1, fig. 3).—Eighth tergum large, with bristles near the spiculose dorsal margin arranged 1–3–4, the last the longest, and with two or three bristles near the ventro-caudal margin. Eighth sternum (*8 S.*) reduced, long and narrow, apically produced into a globular membranous flap with faint striations; without bristles. Intersegmental membrane between eighth and ninth segments enlarged and spiculose, part produced into a prominent rounded or subtruncate process (*PR.*).

Immovable process (*P.* and pl. 2, fig. 1) of clasper conical, apically rounded, elongate, extending as far dorsad as movable finger; with three bristles at apex, the most caudal about

three times the length of the others. Caudal margin of immovable process sharply convex at insertion of acetabular bristles. Movable finger of clasper (*F.* and pl. 2, fig. 1) subequal to immovable process in width; elongate, about five times as long as wide; cephalic margin fairly straight distally, caudal margin gently curving cephalad; ventral margin shallowly concave. Movable finger with six caudal, marginal or submarginal, elongate, mesally inserted stout bristles, the ventral three appearing more as spiniforms. Most distal stout bristle of movable finger, inserted at apical third, is longest, more than three times as long as finger is wide. Two stout bristles, somewhat more than half as long, inserted immediately proximad, above midpoint. Most dorsal submarginal spiniform just proximad of midpoint; most ventral at ventro-caudal angle and somewhat wider than others; the second spiniform almost midway between. Movable finger with three small marginal apical bristles, four or five smaller, scattered mesal bristles, and three such mesal bristles on caudal margin near insertion of finger. Manubrium (*MB.*) narrowing very gradually; somewhat wider at base than tergal apodeme of ninth tergum (*T.AP.9*), which forms dorso-proximal portion of clasper lobe; curved cephalad at bluntly rounded apex. Ninth tergum apparently reduced to an indefinite area between its apodeme and clasper lobe. Subpygidial sclerite of Wagner not apparent, perhaps reduced to a small subcircular median sclerotization on a triangular sclerotized area of the ninth tergum.

Ninth sternum very well developed, boomerang-shaped. Proximal arm (*P.A.9*) of ninth sternum well sclerotized, about five-sixths as long as distal arm; apex acute; dorsal margin convex apically; ventral margin concave apically and triangularly acutely produced proximad of sinus. Distal arm (*D.A.9* and pl. 2, fig. 7) of ninth sternum about twelve or more times as long as wide at base; apical two-thirds biconvex on ventral (apparently caudal) margin, with a prominent sinus separating the two lobes. Proximal lobe of distal arm with two short spiniforms and about four very small bristles on margin. Apical lobe of distal arm distally rounded, with three short spiniforms distad of sinus. Distal arm with a row of fine short bristles extending its length, and a few scattered similar bristles. Morphologically dorsal (apparently cephalic) margin of distal arm with a conspicuous, very long, stout, cephalad-directed bristle inserted at distal third, near the height of a shallow convexity. A much smaller stoutish bristle inserted apicad. Angle of ninth sternum with a rod or spring extending ventro-cephalad, uncoiled, shorter than penis rods (*P.R.*).

Aedeagal apodeme (*AE.A.*, pl. 1, fig. 4) somewhat longer than aedeagus proper (*AED.*), about four times as long as wide, widest at middle but subcylindrical; middle plate somewhat longer than lateral plates, resulting in a proximal spur-like extension. Base of aedeagus proper curving ventrad, convex ventrally. Lateral lobes (*L.L.*) very well developed, arising from base of aedeagus, curving dorso-caudad of median dorsal lobe, sinuate caudally, marginally somewhat sclerotized. Median dorsal lobe (*M.D.L.*) simple, apically bent at right angles, acuminate. Crochets (*CR.*) well developed; ventral margin proximally concave, then straight; dorsal margin strongly biconcave; apex subtruncate with four or five rows of micro-mucrons (pl. 2, fig. 3). Armature of sheath of inner tube (*A.I.T.*) paired and bifid; the dorsal process conspicuous, elongate, tapering somewhat, with sinuate sides and a truncate but slightly expanded apex. Ventral process of armature lightly sclerotized, extending toward crochets. Inner tube (*S.I.T.*) extending somewhat apicad between processes of its armature. A pair of membranous expansions extending distad from inner tube region, reaching ventrad nearly to crochets. Apodemal strut supporting inner tube consisting of narrow lateral lobes and a larger median lobe extending to base of armature of inner tube. Narrow crescentic or rectangular sclerotizations dorsad of heavier lobes of apodemal strut. Penis rods (*P.R.*) not coiled, extending shortly beyond cephalic end of aedeagal apodeme. Ventral intramural rod of endophallus (*I.R.*) well developed.

Tenth abdominal segment conspicuous; sensilium relatively flat; dorsal lobe of proctiger conical, extending dorsad to apex of immovable clasper and with three apical bristles and

proximal small hairs; ventral lobe of proctiger subconical and with a series of marginal bristles, those at apex longest. Proximal ventral sclerite well developed, triangular, with apex cephalad.

Modified Abdominal Segments: Female (pl. 2, fig. 6).— Seventh sternum (*7 S.* and pl. 2, fig. 5) with an acute deep sinus near ventral border, forming two lobes; ventral lobe rounded, extended somewhat more caudad, but distance variable (pl. 2, fig. 5); dorsal lobe acute. Seventh sternum with caudal margin shallowly concave dorsad of acute dorsal lobe. Seventh sternum on each side with a row of 4 (or 3) well-developed bristles and with a very small bristle between third and fourth. Eighth tergum (*8 T.*) with a few small hairs in two rows dorsad of spiracle; four bristles, two very small, ventrad of sensilium; three caudal marginal bristles, one very small, by caudal sinus; one small bristle ventrad of ventral anal lobe; and four bristles near ventral margin, one very small. Eighth sternum (*8 S.*) narrow, without bristles. Dorsal anal lobe with two fairly long dorsal bristles and a few scattered small hairs. Anal stylet (pl. 2, fig. 4) about three times as long as wide at base, with the ventral bristle about one-fourth of the length of the apical, and with a minute vestige of dorsal and subapical bristles. Ventral anal lobe (*V.A.L.*) angulate, with three bristles on ventrocaudal margin, two long apical bristles, and a few marginal or submarginal small hairs. Head of spermatheca (*SP.* and pl. 2, fig. 2) strongly convex above, slightly concave below. Tail of spermatheca slightly longer than head, almost three-fourths as wide as head, and slightly narrower at base, with a very small tubercle at apex. Bursa copulatrix (*B.C.*) with apex bluntly lanceolate.

Records.—Known only from the type host and locality: *Reithrodontomys c. chrysopsis* Merriam (harvest mouse); Mexico, State of Michoacán, Tancítaro, near municipality of Tancítaro; collected at 7,800–10,500 feet altitude, June and July, 1941, by the author.

In the descriptions that follow, unless otherwise indicated, comparisons are made with *J. klotsi,* and only differences are pointed out.

Jellisonia hayesi sp. nov.

Near *klotsi* Traub but with labial palpi and stilettos extending about five-sixths of the length of the procoxae. Male distinct in the following respects: The expansion of the intersegmental membrane between the eighth and ninth segments is triangular, not subtruncate; the eighth sternum is apically narrowed, not expanded; the movable finger has a median spiniform in addition to submarginal ones; the acetabular bristles are inserted on a narrowed expanded truncate portion of the immovable process; the distal arm of the ninth sternum is much more narrowed apically than proximally. The crochets are flask-shaped, with base globular, not narrowed. The dorsal process of the armature of the sheath of the inner tube is straight, not curved, and the apex is expanded. Female without a deep sinus on the seventh sternum, *or* with the dorsal lobe extending more caudad than the ventral lobe.

This species is represented by two subspecies.

Jellisonia hayesi hayesi subsp. nov. Plates 3, 4.

With seven bristles in first preantennal row of bristles (pl. 3, fig. 1, male). First postantennal row with seven bristles. Mesepisternum with two or three fine thin bristles near cephalic margin, with one similar and two much larger median bristles, and with two longer caudal bristles. Mesepimeron with six bristles in two rows of three. Metepimeron with

seven bristles arranged 3–3–1. Proportionate measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	156	73	67	57	45	86
Meso-	272	150	108	72	52	96
Meta-	352	256	172	102	60	102

Abdominal terga with apical spinelets arranged 1–2–1–1. Male sterna three to six with two bristles, at times with three; female with three.

Modified Abdominal Segments: Male (pl. 3, fig. 3).—Eighth tergum with bristles on dorsal half arranged 1–2–4, the last very long; two large bristles near ventro-caudal margin. Eighth sternum (*8 S.*) reduced to a very narrow elongate structure without bristles but apically with delicate tiny frayed extensions (pl. 3, fig. 4). Intersegmental membrane between eighth and ninth segments greatly enlarged to form a conspicuous, filamentous, spiculose, marginally finely tufted triangular process (*PR.*) extending caudad as far as apex of distal arm of ninth sternum.

Immovable process of clasper (*P.* and pl. 4, fig. 1) conical but caudal margin apically curving cephalad and ventrally produced caudad into a relatively narrow truncate expansion bearing the acetabular bristles. Movable finger (*F.* and pl. 4, fig. 1) more than one and one-half times as wide as immovable process; ventral margin straight; two marginal long stout bristles mesially inserted near apical third, a thin mesal spiniform inserted basad of the most ventral bristle; a mesal submarginal spiniform inserted at ventral third; a median mesal stouter spiniform inserted near origin of acetabular bristles; another stout submarginal mesal spiniform near ventro-caudal angle; a few thin marginal bristles as shown in figure. Distance from apex of tergal apodeme of ninth segment (*T.AP.9*) to immovable finger almost twice the length of the slightly constricted, apically rounded manubrium.

Distal arm of ninth sternum (*D.A.9* and pl. 4, fig. 3) caudally with a prominent bulge or lobe bearing two small marginal spiniforms and about fifteen long thin bristles, many marginal; apical portion caudally shallowly convex, apically gradually narrowed, forming a broad ellipse with about twenty bristles, mostly long and thin; submarginal cephalic border with a thin bristle apicad of cephalad-directed long spiniform.

Aedeagal apodeme (*AE.A.*, pl. 3, fig. 5) somewhat arched medially. Lateral lobes (*L.L.*) more vertical than in *J. klotsi*, extending more ventrad; caudal margin doubly though shallowly sinuate, well sclerotized marginally. Median dorsal lobe (*M.D.L.*) consisting apically of approximately appressed, narrow acuminate dorsal and ventral sections; dorsal member with a somewhat concave outer margin. Crochets (*CR.*) well developed, flask-shaped, with base globular and neck gently upcurved; apex subconical, with about six rows of micro-mucrons. An elongate sclerotization extending from dorsal margin of base of aedeagus to base of crochet. Armature of sheath of inner tube (*A.I.T.*) with dorsal process subrectangular and truncate. Inner tube (*S.I.T.*) sclerotized apicad of armature, curved like a blunt hook.

Modified Abdominal Segments: Female (pl. 4, fig. 4).—Seventh sternum (*7 S.*) with dorsal margin shallowly concave and produced into a long acuminate lobe; sinus ventrad of dorsal lobe twice width of that lobe; ventral lobe broad, evenly rounded. Seventh sternum with four long bristles immediately preceded by an irregular row of three smaller ones. Spermatheca (*SP.*, pl. 4, figs. 4, 5) of same general type but somewhat distorted in specimen. Anal stylet (pl. 4, fig. 6) narrower, about four times as long as wide at base.

Holotype.—A male from Mount San Miguel, Michoacán, Mexico, at 6,500 feet altitude, near the municipality of Tancítaro. Collected July 31, 1941, by

Robert Traub. In the collection of Chicago Natural History Museum. Host: *Peromyscus hylocetes* Merriam.

Allotype.—A female, same data and depository as the holotype.

Paratype.—A male, same data as the holotype. In the collection of Robert Traub.

Remarks.—This species is named for Professor W. P. Hayes of the Department of Entomology of the University of Illinois, to whom I am greatly indebted.

Jellisonia hayesi breviloba subsp. nov. Plate 5, figs. 1–3.

Specimens from Mexico City closely resemble the typical *hayesi* in general and in details of the male claspers, but are abundantly distinct.

Seventh sternum of female (pl. 5, fig. 2) only somewhat angulate on dorso-caudal margin, lacking a conspicuous acuminate lobe; six bristles, not seven. Distal arm of male ninth sternum (pl. 5, fig. 1) with apex much more narrowed, making an angle of about 45 degrees instead of the 60 degrees or more of the typical form. Distal arm lacking the prominent proximal lobe, merely slightly convex in area bearing the two small spiniforms.

Holotype.—A female from Mexico, D. F., Mexico ("near country club"). Collected May 10, 1933, by Dr. Alfonso Dampf. In the collection of Chicago Natural History Museum. Host: *Microtus mexicanus* Saussure.

Allotype.—A female, same data as the holotype. In the collection of Chicago Natural History Museum.

Paratypes.—A pair, same data as the holotype. In the collection of Dr. Alfonso Dampf.

Remarks.—I am greatly indebted to Dr. Dampf for permission to study and describe this subspecies and to use his fine drawing (pl. 5, fig. 1).

Jellisonia dybasi sp. nov. Plate 5, figs. 4–6.

Only the female is known. Close to *klotsi* but with sinus of seventh sternum more obtuse, forming an angle of about 40 degrees, and with two small bristles and three large ones, instead of one small and four large bristles. Eighth tergum with two submedian ventral bristles, not three. Mesepimeron with six, not seven, bristles. First segment of mesotarsus relatively smaller, not definitely more than twice the length of the third segment.

Head with seven small bristles in first preantennal row; four bristles in second row, the second most ventral bristle very small; three in most caudal row. Labial palpi extending about three-fourths the length of the procoxae. Postantennal rows of bristles arranged 4–5–5; the most caudal the longest. Mesepisternum with three bristles, the first very small. Mesepimeron with bristles arranged 3–1–2. Metepimeron with bristles arranged 4–4–1. Tibial comb of eight short and subequal bristles. Proportionate measurements of tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	176	66	66	47	37	83
Meso-	282	154	105	78	50	96
Meta-	370	256	172	108	66	102

Seventh sternum (pl. 5, fig. 4, *7 S.*) with dorso-caudal margin shallowly concave; with a deep sinus near the ventral margin, the margins of the sinus forming an angle of about 40 degrees, the resulting dorsal lobe somewhat rounded; ventral lobe almost twice as wide as dorsal lobe, rounded. Seventh sternum with five bristles arranged as in figure. Ventral portion of eighth tergum (*8 T.*) with two submedian bristles, two submarginal bristles and three marginal ones. Spermatheca with tail as long as head and recurved over part of head. Anal stylet (pl. 5, fig. 6) like that of *J. klotsi* in proportions and presence of minute, vestigial dorsal and subapical bristles.

Holotype.—A female from Acajete, State of Vera Cruz, Mexico. Collected from "rodent nest under rock in field," July 30, 1941, by Henry S. Dybas. In the collection of Chicago Natural History Museum.

Remarks.—The species is named for the collector, Mr. Henry S. Dybas of Chicago Natural History Museum, who has helped me on many occasions.

Jellisonia ironsi (Eads). Plates 6, 7.

Trichopsylla (*Pleochaetis*) *ironsi* Eads, Ann. Ent. Soc. Amer., **39**, (4), p. 545, figs. 1–5, 1946.

Near *klotsi* Traub and *hayesi* sp. nov., but male without short proximal spiniforms on distal arm of ninth sternum; intersegmental membrane between eighth and ninth segments not produced into a prominent bulge or flap; movable finger wider, twice as wide as immovable process; and one or two mid-ventral bristles on eighth sternum. Aedeagus with a bifid median dorsal lobe and an accessory lateral tongue-like sclerotization dorsad of lateral lobe of apodemal strut. Female distinct in possessing seven ventro-caudal marginal bristles on eighth tergum instead of two or three. Both sexes with first segment of mesotarsus relatively much shorter than in *klotsi* and *hayesi*, less than twice the length of the third segment.

Preantennal region with one or two small accessory bristles in irregular first row so that total is nine or ten (pl. 6, fig. 1). Labial palpi and stilettos extending about five-sixths the length of procoxae. Mesepimeron with seven or eight bristles in irregular rows; usually with four in first row. Metepimeron with about five bristles. Tibial bristles mainly paired so that characteristic comb is apparent only on protibiae, and there reduced. Proportionate measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	57	64	51	44	83
Meso-	290	112	96	66	47	86
Meta-	340	233	160	102	60	99

Abdominal terga with apical spinelets arranged 1–2–1–1. Abdominal sterna three to six with two bristles.

Modified Abdominal Segments: Male (pl. 6, fig. 4).—Eighth tergum with ten bristles: two small, dorsal, marginal; two adjacent, longer; one adjacent, submarginal; three large, median; two large, subventral. Eighth sternum (*8 S.* and pl. 7, fig. 6) reduced to a narrow flap; biconcave dorsally; widest at middle and apically sharply curving dorsad, acuminate; with subapical fine filamentous tufted projections, spiculose near insertion of midventral bristle (some with two bristles). Intersegmental membrane between eighth and ninth segments (*I.M.*) spiculose, only slightly expanded, not produced into a truncate or triangular flap.

Immovable process of clasper (*P.* and pl. 7, fig. 1) conical though apically rounded, extending distad almost as far as apex of movable finger; caudal margin slightly produced caudad, truncate, at insertion of acetabular bristles. Movable finger (*F.* and pl. 7, fig. 1) about twice as wide as immovable process; ventral margin slightly concave; five marginal or submarginal, mesally inserted, long stout bristles or spiniforms on caudal margin, the most ventral the stoutest.

Distal arm of ninth sternum (*D.A.9* and pl. 7, fig. 5) clavate, with apex narrowed; caudal margin not sinuate and lobes therefore lacking; about 13 marginal or submarginal bristles, three (near midpoint) much stouter than the others; about 15 smaller thinner scattered bristles, lacking small stout bristle apicad of stout long spiniform on cephalic margin.

Aedeagal apodeme (*AE.A.*, pl. 6, fig. 5) tapering gradually. Lateral lobes (*L.L.*) evenly rounded caudally. Median dorsal lobe (*M.D.L.*) bifid, each fork acuminate, not angled; ventral fork with a lightly sclerotized extension to inner tube. Crochets (*CR.*) with margins almost parallel, base proximally convex, apically somewhat pointed; about six rows of micro-mucrons. Armature of sheath of inner tube (*A.I.T.*) paired; broad, apically widened; caudal margin sinuate and produced into a ventral acuminate blade. Inner tube (*S.I.T.*) apicad of armature truncate, caudally produced and curved ventrad. Dorsal margin of aedeagus produced into a pair of elongate, lateral, triangular, tongue-like projections, herein designated accessory lateral lobes (*A.L.L.*), and extending dorsad of apodemal strut to region of inner tube; apex acute.

Modified Abdominal Segments: Female (pl. 7, fig. 4).—Seventh sternum (*7 S.*) with dorso-caudal margin shallowly concave, acutely angled and then curving sharply ventrad, forming a pointed, caudad-directed lobe, with a row of five bristles preceded by two smaller ones. Eighth tergum with four ventral marginal bristles, four ventro-caudal marginal bristles, and two subventral median bristles. Spermatheca (*SP.* and pl. 7, fig. 2) of same general type.

Records.—Known only from the records of the Texas State Health Department. Texas: Hallettsville and Yoakum, from *Baiomys taylori* Thomas, March and April, 1946.

Jellisonia bullisi (Augustson). Plates 8, 9.

Pleochaetoides bullisi Augustson, Jour. Parasit., **30**, p. 366, 4 figs., 1944 (male only).

This species is at the end of an evolutionary line in the genus with respect to the width of the movable finger and the development of the tibial comb. Considering those species for which males are known, the series is *klotsi, hayesi, ironsi, bullisi.* In *bullisi* the movable finger is very much wider, about four times the width of the apical portion of the immovable process. Many of the dorso-lateral tibial bristles are paired and hence the tibial comb is not apparent.

Nearest to *ironsi* in that the male eighth sternum is of the same general structure and bears a subventral bristle; in that the distal arm of the ninth sternum lacks caudal lobes and short spiniforms; and in that the intersegmental membrane between the eighth and ninth segments is not produced into a flap. Agrees with *ironsi* in that the aedeagus possesses a bifid median dorsal lobe and an accessory lateral lobe.

Unique in the great width of the movable finger; in the reduction of the armature of the sheath of the inner tube and in that the female seventh sternum is not bilobed or angulate.

Agrees with *klotsi* and *ironsi* except as noted. First preantennal row of bristles with seven bristles (pl. 8, fig. 1). Labial palpi longer than in *klotsi*, extending about five-sixths the length of procoxae. Mesepisternum typically with three bristles, one median and two caudal. Mesepimeron with six bristles in two rows of three. Metepimeron with five bristles arranged 2–3–1. Proportionate measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	170	57	57	51	41	96
Meso-	260	116	89	64	48	96
Meta-	340	256	176	108	48	106

As in *ironsi*, abdominal terga with apical spinelets arranged 1–2–1–1 and abdominal sterna three to six with two bristles.

Modified Abdominal Segments: Male (pl. 8, fig. 3).—Eighth tergum with only five large and two small bristles: two small dorsal bristles, marginal or submarginal; two large bristles similarly placed but immediately caudad; one large submedian bristle; and two subcaudal and median bristles. Eighth sternum (*8 S.* and pl. 9, fig. 6) resembling that of *ironsi* but apex not extended dorsad; dorsal margin not biconvex, and spiculose portion caudad, not cephalad, of bristle. Intersegmental membrane (*I.M.*) between eighth and ninth segments only slightly expanded, spiculose.

Immovable process of clasper (*P.* and pl. 9, fig. 1) with cephalo-dorsal margin curving ventrad for less than one-half the length of the process, so that immovable process is not conical for most of its length; extending almost as far distad as movable finger; two thin apical bristles; caudal margin mildly sinuate and curving ventrad at insertion of acetabular bristles. Movable finger (*F.* and pl. 9, fig. 1) rhomboidal, about four times the width of the conical portion of the process; four marginal and one submarginal, long, very stout subequal bristles on caudal margin, the submarginal bristle the most ventral.

Distal arm of ninth sternum (*D.A.9* and pl. 9, fig. 5) clavate, but with apex broad, rounded; cephalic margin sinuate, with a well-developed bristle apicad of the very long stout bristle, with scattered thin median and submarginal bristles and with four larger proximal marginal bristles.

Aedeagus much like that of *ironsi*. Aedeagal apodeme (*AE.A.*, pl. 8, fig. 4) slightly narrowed in proximal half. Lateral lobes (*L.L.*) with a shallow dorsal sinus on caudal margin. Median dorsal lobe bifid, the forks acuminate, subequal, and straight. Crochets (*CR.*) narrower medially, slightly constructed; base concave. Armature of sheath of inner tube (*A.I.T.*) apparently reduced to a linear sclerotization which is connected with the apex of the lower fork of the median dorsal lobe. Apex of inner tube (*S.I.T.*) subtruncate, expanded caudad. Accessory lateral lobe more acute, extending distad of inner tube.

Modified Abdominal Segments: Female (pl. 9, fig. 3).—Caudal margin of seventh sternum (*7 S.*) almost straight, curving caudad near ventral fourth; evenly rounded at ventro-caudal angle. Seventh sternum with five large bristles preceded by a smaller one between third and fourth. Ventral and ventro-caudal portion of eighth tergum with five long bristles arranged as in figure. Spermatheca (*SP.* and pl. 9, fig. 2) of the same general type.

Records.—Originally described from white-footed mice, *Peromyscus* sp., Camp Bullis, Bexar County, Texas. Other records: Texas, Sutton County ex *Peromyscus eremicus* Baird (records of Dr. F. M. Prince of the United States Public Health Service); Mexico, Sabinas Hidalgo, Nuevo Leon, three males and two females ex "Mouse (*Peromyscus?*)," June, 1940, collected by K. L. Knight on the Third Hoogstraal Biological Expedition. Allotype female from last collection; deposited in Chicago Natural History Museum.

Remarks.—The figures were drawn from the Mexican specimens; the latter are very similar to those from Texas.

Comment on the Genus Jellisonia

The known males of *Jellisonia* fall into two groups. In *klotsi* and *hayesi*, the tibial comb is well developed; the first segment of the mesotarsus is long, more than twice the length of the third segment; the median dorsal lobe of the aedeagus is simple, not bifid; the accessory lateral lobe of the aedeagus is not apparent; the eighth sternum is greatly reduced and without bristles; the movable finger is less than twice the width of the conical portion of the immovable process of the clasper; and the distal arm of the ninth sternum bears short marginal spiniforms. In *bullisi* and *ironsi* the tibial comb is almost inapparent; the first segment of the mesotarsus is relatively much shorter, definitely less than twice the length of the third segment; the median dorsal lobe of the aedeagus is bifid; the accessory lateral lobe is well developed; the eighth sternum is medially expanded and bears a bristle; the movable finger is two or more times as wide as the conical portion of the immovable clasper; and the distal arm of the ninth sternum lacks short marginal spiniforms.

Study of additional species is necessary before it can be stated that these are valid differences for the delimitation of subgenera.

KEY TO KNOWN SPECIES OF *JELLISONIA*[1]

1. Males[2] 2
   Females 6

2. Median dorsal lobe of aedeagus simple, not divided into two acuminate lobes (pl. 1, fig. 4, *M.D.L.*); movable finger less than twice as wide as conical portion of immovable process (pl. 2, fig. 1); distal arm of ninth sternum with short marginal spiniforms (pl. 2, fig. 7); accessory lateral lobe of aedeagus absent (pl. 1, fig. 4) .. 3
   Median dorsal lobe apically bifid, with two acuminate lobes (pl. 8, fig. 4, *M.D.L.*); movable finger two or more times width of conical portion of immovable process (pl. 7, fig. 1); distal arm of ninth sternum lacking short marginal spiniforms (pl. 7, fig. 5); accessory lateral lobe present (pl. 8, fig. 4, *A.L.L.*) 5

3. Labial palpi extending about three-fourths length of procoxae (pl. 1, fig. 1, *L.P.*); movable finger with all spiniforms marginal or submarginal (pl. 2, fig. 1); eighth sternum distally globularly expanded (pl. 1, fig. 3, *8 S.*); base of crochets narrowed (pl. 1, fig. 4, *CR.*) ..... *klotsi* Traub 1944 (p. 14)
   Labial palpi extending about five-sixths length of procoxae (pl. 3, fig. 1, *L.P.*); movable finger with median spiniform in addition to marginal or submarginal ones (pl. 4, fig. 1); eighth sternum apically narrowed (pl. 3, fig. 3, *8 S.*); crochets with base globular (pl. 3, fig. 5, *CR.*) 4

4. Distal arm of ninth sternum with apex broad, forming an angle of about 60°, and with prominent proximal lobe (pl. 4, fig. 3).
   hayesi hayesi sp. and subsp. nov. (p. 17)

[1] Only one character in couplet need apply.

[2] The male of *J. dybasi* sp. nov. is unknown.

Distal arm of ninth sternum with apex narrowed, forming an angle of 45°, and with proximal lobe reduced to a bulge (pl. 5, fig. 1).
hayesi breviloba sp. and subsp. nov. (p. 19)

5. Movable finger more than three times width of conical portion of process (pl. 9, fig. 1); apex of distal arm of ninth sternum broadly rounded (pl. 9, fig. 5); base of crochet concave (pl. 8, fig. 4, *CR.*) ..... *bullisi* (Augustson 1944) (p. 21)
Movable finger less than three times width of conical portion of process (pl. 7, fig. 1); apex of distal arm of ninth sternum narrowed (pl. 7, fig. 5); base of crochet convex (pl. 6, fig. 5, *CR.*) ..... *ironsi* (Eads 1946) (p. 20)

6. Seventh sternum with deep sinus so that margin is bilobed, dorsal lobe acute (pl. 2, fig. 6, *7 S.*) 7
Seventh sternum lacking deep sinus, at most shallowly concave; acute dorsal lobe absent (pl. 7, fig. 4, *7 S.*) 9

7. Seventh sternum with ventral lobe very large, more than five times width of dorsal lobe (pl. 4, fig. 4, *7 S.*); with labial palpi extending about five-sixths length of procoxae (pl. 3, fig. 1, *L.P.*) ..... *hayesi hayesi* sp. and subsp. nov. (p. 17)
Seventh sternum with ventral lobe less than four times width of dorsal lobe (pl. 2, fig. 6, *7 S.*); labial palpi only about three-fourths length of procoxae (pl. 1, fig. 1, *L.P.*) 8

8. Seventh sternum with sinus very acute, forming an angle of about 30° (pl. 5, fig. 4, *7 S.*); seventh sternum with three large bristles and two small ones; first segment of mesotarsus not definitely more than twice length of third segment.
dybasi sp. nov. (p. 19)
Seventh sternum with sinus more obtuse, forming an angle of about 40° (pl. 2, fig. 6, *7 S.*); seventh sternum with four large and one small bristle; first segment of mesotarsus more than twice length of third segment ..... *klotsi* Traub 1944 (p. 14)

9. Seventh sternum angulate, with submedian caudad-directed pointed lobe (pl. 7, fig. 4, *7 S.*) ..... *ironsi* (Eads 1946) (p. 20)
Seventh sternum evenly rounded, even if shallowly sinuate 10

10. Seventh sternum with caudal margin directed almost straight ventrad for most of its length, curving caudad to form a lobe near ventral margin (pl. 9, fig. 3, *7 S.*).
bullisi (Augustson 1944) (p. 21)
Seventh sternum with caudal margin directed ventro-caudad to midpoint, then mildly sinuate and directed ventrad (pl. 5, fig. 2).
hayesi breviloba sp. and subsp. nov. (p. 19)

REVISION OF THE GENUS *PLEOCHAETIS* JORDAN

Genus **PLEOCHAETIS** Jordan

Pleochaetis Jordan, Nov. Zool., **39**, p. 77, 1933.
Ceratophyllus (*Pleochaetis*), Ioff, Zeitschr. f. Parasitenk., **9**, p. 99, 1936.
Pleochaetis, Jellison and Good, Bull. Nat. Inst. Health, **178**, p. 125, 1942.
Trichopsylla Ewing and Fox, Misc. Publ. U. S. Dept. Agric., **500**, p. 65, 1943.
Pleochaetis, Hubbard, Fleas W. N. Amer., p. 246, 1947.

Genotype: *Ceratophyllus mundus* Jordan and Rothschild 1922.

The genus *Pleochaetis* parasitizes small rodents and ranges at least from northern South America through Central America and Mexico to the south-

western United States. Although the species are of potential medical importance, records have been scarce and as a whole the group has been relatively little studied. Until recently, some of the species have been known from only one sex.

In the original diagnosis of the genus, Dr. Jordan said that the species probably represented at least two genera. His keen observation is verified by material available to me for study. Included are eleven new species or subspecies obtained from either Chicago Natural History Museum or the San Francisco Plague Laboratory, or collected by myself in Mexico. A re-definition of the genus and the creation of a new genus are therefore pertinent. As Dr. Jordan kindly points out (in litt.), *Dasypsyllus* Baker, an essentially neotropical genus of bird-fleas, is "nearly related to *Pleochaetis* s. lat. and evidently derived from this branch of fleas."

Genus **PLEOCHAETIS** Jordan s. str.

Frontal tubercle distinct. Preantennal region with two or three rows of bristles. Eye well pigmented. Genal ctenidium absent. Second segment of antenna with bristles shorter than clavus. Postantennal region with three rows of bristles—two (or more) bristles caudad of base of antennal groove, three or more near middle, and a third row of four or five, rarely with these rows 1–2–4. Labial palpi not extending beyond apex of procoxae. Prothoracic ctenidium of about eighteen or twenty spines. Profemora each with about five small lateral bristles. Meso- and metacoxae without small mesal bristles on proximal half. Dorso-lateral bristles of tibiae paired, not forming a comb. Hind tarsi lacking long bristles, and with most proximal pair of plantar bristles only slightly displaced ventrad. First four or five abdominal terga with apical spinelets; typical abdominal terga with two rows of bristles. Only one antepygidial bristle well developed in male, three in female. Spiracle of eighth tergum larger than those of other terga, but not unusually enlarged. Distal arm of male ninth sternum lacking spiniforms, angle with an apodemal rod; apex of proximal arm of ninth sternum truncate. Manubrium apically broad and subtruncate, about one-third as broad as cephalic margin of apodeme of ninth tergum. Movable finger with marginal stout bristles or spiniforms. Two acetabular bristles present.

Aedeagal apodeme with apical appendage or spur. Lateral lobes of aedeagus covering proximal half or two-thirds of end chamber, but leaving most of inner tube exposed; aedeagus constricted before expanded end chamber, forming a neck. Median dorsal lobe talon-shaped but simple, not flared and convoluted. Crochets apically subrectangular or beak-shaped. Armature of sclerotized inner tube reduced, but apex somewhat expanded. Intersegmental membrane between male eighth and ninth segments at most feebly expanded. X-gland of Wagner well developed. Male eighth sternum fairly long and narrow, with marginal and/or apical bristles. Anal stylet of female flask-shaped, with dorsal and ventral bristles well developed. Head of spermatheca longer than broad, subovate or vermiform, but not strongly convex.

Discussion.—As here defined, *Pleochaetis* Jordan, s. str., includes, in addition to the genotype *P. mundus*, *P. apollinaris* (Jordan and Rothschild 1921), *P. dolens* (Jordan and Rothschild 1914), *P. equatoris* (Jordan 1933), *P. sibynus* (Jordan 1925), and the new species described below. *P. graphis* (Rothschild 1909) and *campaniger* (Jordan 1931) are placed in a new genus described below, subsequent to the consideration of *Pleochaetis*, s. str.

The known males of *Pleochaetis* (s. str.) fall into two definite groups. *P. sibynus* and its allies are characterized by the possession of a movable finger

that is not clavate but is instead evenly rounded caudo-apically, and bears no apical spiniforms. In this group the aedeagal apodeme is convex dorsally and ventrally and bears a very long apical appendage or spur that is more than half its length. The aedeagal crochets are subrectangular; the aedeagus lacks accessory lateral lobes; the sclerotized apex of the aedeagal inner tube is flattened and expanded, and the membranous portion of the everted inner tube extends far distad; the penis rods are coiled once or twice. The apodemal strut consists of two distinct sclerites ventrad to the crescent sclerite. The distal arm of the ninth sternum typically bears long marginal bristles on the proximal lobe and the apical lobes are subovate. In contrast, in *mundus* and its allies, the movable finger is clavate or subclavate and bears apical spiniforms or a single stout apical bristle; the aedeagal apodeme has subparallel sides and only a short apical spur (less than one-fourth its length); the aedeagal crochets are distally beak-shaped; the aedeagus has definite but narrow accessory lateral lobes; the sclerotized apex of the inner tube is recurved and has a narrow tongue extending distad into the extended submembranous portion; and the penis rods are uncoiled. The apodemal strut consists of three sclerites ventrad to the crescent sclerite. The apical lobe of the distal arm of the ninth sternum is somewhat narrowed and inclined apically, while the proximal lobe is without long curved bristles or their number is reduced. These differences may prove to be fundamental, denoting subgenera, but in view of the fact that many species probably remain to be discovered, no nomenclatural changes are proposed. Below is described a species in which the two known females possess vermiform spermatheca; the male is unknown. This species may also prove to represent a distinct subgenus, perhaps even a new genus. A new species, representing the *P. sibynus* group, which includes most of the species, is described first.

Pleochaetis mathesoni sp. nov. Plates 10, 11.

Near *P. sibynus* (Jordan 1925) but readily separated as follows: Movable finger narrower, more than three times as long as wide at maximum, and with three long thin marginal bristles distad of long stout bristle at mid-point (pl. 11, fig. 1); not definitely less than three times as long as wide and with the three marginal bristles almost as stout as the pronouncedly thick middle bristle. Proximal lobe of distal arm of male ninth sternum with three long bristles, the distalmost about one-half the length of the proximal (pl. 11, fig. 2). In *P. sibynus* there are five or six long bristles (pl. 13, fig. 2). Neck at base of aedeagus long and narrow, about four times as long as wide (pl. 10, fig. 4, *N.*), not with length merely subequal to width (pl. 12, fig. 4, *N.*). Male eighth tergum with one ventral bristle (pl. 10, fig. 2), not two (pl. 12, fig. 2). Head with an additional large median bristle in irregular first row of preantennal region and with an additional one or two bristles on first two postantennal rows (pl. 10, fig. 1). Spermatheca with head broader and with sides constricted at proximal fourth and then subparallel (pl. 11, fig. 4), not subovate (pl. 13, fig. 5).

Male and Female: Head (pl. 10, fig. 1, male).—Anterior margin evenly rounded, with frontal tubercle median and small, but distinct. Preantennal region with first row of bristles

very irregular, consisting of about six small and three larger bristles (the last sometimes appearing as a distinct row), and an ocular row of three long bristles, the middle of which is the smallest. With a series of very small setae along ventral border of antennal fossa and thinly scattered on gena. Eye conspicuous, subovate, well pigmented. Genal process fairly broad, becoming acuminate. Maxillary lobe (*MX.*) an acute triangle, extending to near apex of third segment of maxillary palpi. Maxillary laciniae (*LAC.*) about one-third diameter of labial palpi; with apical half denticulate or microserrate. Lacinial and epipharyngeal stilettos (*EPX.*) subequal, and, like the five-segmented labial palpi (*L.P.*), extend nearly to apex of forecoxae. Scape of antenna long, almost as long as subovate nine-segmented clavus, with two or three very small marginal setae near insertion, somewhat longer ones subapical, and apical. Second segment of antenna with somewhat longer setae, but those in male extending less than one-fourth length of clavus, in female less than one-half. An irregular row of very small bristles along the dorsal margin of the antennal fossa. Postantennal region with three rows of bristles arranged 4(5)–5–4(5), the most caudal the longest, and with an extra bristle in female at ventro-caudal angle; with small hairs interpolated between some of the large bristles.

Thorax.—With five long bristles preceding the nine or ten pronotal ctenidial spines on each side. A few small hairs intercalated between some of the bristles. Mesonotum with similar hairs along thickened cephalic margin and with three rows of bristles, the caudalmost the longest, preceded by a few small hairs. Mesonotum with three apical seta-like extensions suggesting thin elongate spinelets. Mesepisternum (*MPS.*) usually with three bristles near ventro-caudal angle, preceded by thin scattered small hairs. Usually with eight bristles on mesepimeron (*MPM.*) arranged as in figure. Metanotum with three rows of bristles, the first incomplete; an apical spinelet on metanotal flange. Lateral metanotal area well developed, quadrate, with two bristles near caudal margin. Metepisternum with one bristle in dorso-caudal angle. Metepimeron with seven bristles arranged 3–3–1, at times with eight arranged 2–2–3–1.

Legs.—Meso- and metacoxae with a submedian lateral sclerotization and a mesal, somewhat trident-shaped longitudinal sclerotization; cephalic arm of the trident reduced to a spur, caudal arm proximally joining the lateral sclerotization. Profemora with about ten small thin lateral median bristles; meso- and metafemora with one each. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	147	61	64	55	45	86
Meso-	266	112	109	74	48	86
Meta-	340	268	173	112	61	106

None of tarsal bristles reaching beyond apex of following segment; apical bristles of third metatarsal segment subequal to fourth segment. Distal tarsal segment of each leg with four pairs of lateral plantar bristles and with basal pair slightly displaced medially. Blade of unguis about twice length of thickened recurved basal portion.

Abdomen.—First tergum with three rows of bristles, the first row very incomplete. Male with two apical very small teeth on each side of first and second terga; third and fourth terga with one. Female with tergal teeth 2–2–2–1. Caudal row of bristles on abdominal segments two to six much longer than those of cephalic row and extending somewhat ventrad of spiracles. Basal sternum with a series of fine whorled striae suggesting fingerprints, with one bristle near ventral margin of basal sternum. Sterna three to six of male with three or four bristles preceded by one or two much smaller ones; female with four such bristles preceded by a horizontal row of several much smaller ones. Male with middle antepygidial

bristle well developed, others minute (pl. 10, fig. 3, *A.B.*). Female with middle antepygidial bristle more than twice the length of dorsal and ventral ones (pl. 11, fig. 6, *A.B.*).

Modified Abdominal Segments: Male (pl. 10, fig. 3).—Eighth tergum large, covering most of genitalia; slightly spiculose caudad of sensilium; with two small and three (or four) long dorsal bristles and six median and submedian bristles arranged as in pl. 10, fig. 2. Eighth sternum (*8 S.* and pl. 11, fig. 3) long and narrow; with a ventral row of about six thin bristles and a long apical bristle; dorsal margin membranous and frayed apically. Intersegmental membrane between eighth and ninth segments somewhat enlarged near angle of ninth sternum, spiculose.

Immovable process of clasper (*P.* and pl. 11, fig. 1) broadly conical; with three small apical bristles and with a broad shallow sinus on caudal margin. Movable finger of clasper (*F.* and pl. 11, fig. 1) subclavate, with proximal half gradually widening; broadest at insertion of mesal marginal stout bristle or subspiniform at level of apex of *P.* Caudal margin of movable finger rounded distad of stout bristle and bearing three marginal, long, thin though dark mesal bristles inserted at subequidistant points, and with small marginal and submarginal bristles as in figure. Cephalic margin of movable finger fairly straight, although produced into a short point near midpoint and with a short acute apical angle. Manubrium (*MB.*) with margins subparallel for most of their length, apex broad; base somewhat narrower than tergal apodeme of ninth tergum (*T.AP.9*) which forms dorso-proximal portion of clasper lobe. Ninth tergum apparently reduced to an indefinite area between its apodeme and clasper lobe. Subpygidial sclerite of Wagner apparently reduced to a thin linear sclerotization near dorsal margin of immovable clasper.

Ninth sternum very well sclerotized, boomerang-shaped. Proximal arm (*P.A.9*) about as long as distal arm; apically somewhat angled; with apex truncate; dorsal margin shallowly convex, ventral margin subparallel. Distal arm (*D.A.9* and pl. 11, fig. 2) long and bilobed. Proximal lobe of distal arm with two or three very long marginal bristles; a bristle half as long inserted at apex; smaller marginal bristles inserted as in figure. Distal lobe subovate with two small bristles on cephalic margin; a few scattered bristles median or near cephalic margin. The proximal and distal lobes connected by a small mesal lobe bearing a relatively thick bristle. Angle of ninth sternum with apodemal rod (pl. 10, fig. 3, *AP.R.9*) very long and apically coiled.

Aedeagal apodeme (pl. 10, fig. 4, *AE.A.*) longer than aedeagus proper; widest at middle, tapering apically; middle plate longer than lateral plates, resulting in a long apical appendage (*AP.A.*) about half length of apodeme. Proximal spur (*P.S.*) present. Base of aedeagus with a long narrow neck (*N.*), about four times as long as wide (measured between rapidly flaring ends). Expanded endchamber less than twice width of aedeagal apodeme. Lateral lobes (*L.L.*) covering base of aedeagus; ovate median dorsal lobe (*M.D.L.*) simple, proximally thick, rapidly becoming acuminate, curved, talon-like. Crochets (*CR.*) very well developed; base dorsally subglobular; dorsal margin concave, ventral margin subparallel, apically truncate; with a barrel-shaped or peg-like sclerotization near base. Armature of sheath of inner tube (*L.S.I.*) represented. Apex of sclerotic inner tube (*A.S.I.*) expanded and subtruncate, with extra-aedeagal portion (*E.I.T.*) extending far distad and recurved cephalad. Apodemal strut supporting inner tube consisting on each side of a narrow submedian mesal lobe (*M.S.*) and a larger latero-ventral curved lobe (*L.S.*) extending to base of sheath of inner tube. Dorsad of strut a narrow somewhat convex sclerite, the crescent sclerite (*C.S.*). Penis rods (*P.R.*) very long, coiled. Ventral intramural rod of endophallus (*I.R.*) well developed.

Tenth abdominal segment conspicuous; with sensilium relatively flat; dorsal lobe of proctiger subconical, with three or four apical bristles and proximal small hairs; ventral lobe of proctiger subconical and with a tuft of apical bristles. Proximal ventral sclerite represented by a subtriangular dark area.

Modified Abdominal Segments: Female (pl. 11, fig. 6).—Seventh sternum (*7 S.*) dorso-caudally concave; usually with a caudal sinus forming a narrow subtruncate dorsal lobe and a much wider, more often rounded ventral lobe. Variations in shape of seventh sternum shown in pl. 11, fig. 8. Seventh sternum with a cephalic row of five small and a caudal row of four long bristles. Eighth tergum (*8 T.*) with two long bristles ventral to sensilium, with five marginal bristles and four submarginal ventral bristles as in figure. Eighth sternum (*8 S.*) narrow, without bristles. Dorsal anal lobe (*D.A.L.*) with scattered bristles, the longest marginal. Anal stylet (pl. 11, fig. 7) about 2½ times as long as wide at base; with dorsal and ventral bristles subequal, less than one-third length of apical bristle. Ventral anal lobe (*V.A.L.* and pl. 11, fig. 5) angulate; four stout curved bristles on ventro-caudal angle, the smallest nearest the angle; with five long apical bristles and a few submarginal small hairs. Spermatheca (*SP.* and pl. 11, fig. 4) with head less than twice as long as wide; broadest near tail and with margins fairly straight distad of constriction. Tail of spermatheca very stout, slightly longer than head.

Holotype.—A male from Mount Tancítaro, at 8,000 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico; collected July 12, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Reithrodontomys c. chrysopsis* Merriam (a harvest mouse).

Allotype.—A female, same locality, host, and collector as the holotype: collected July 5, 1941, at 7,800 feet altitude. In the collection of Chicago Natural History Museum.

Paratypes.—One hundred and five males and one hundred females, same locality as the holotype and mostly from the same host (some from *Peromyscus hylocetes* Merriam at 7,800 feet alt.), taken between 7,800 and 9,000 feet. Deposited in the collections of Chicago Natural History Museum; United States National Museum, Cornell University; Museum of Comparative Zoology, Harvard College; Rocky Mountain Laboratory, Hamilton, Montana; Dominion Entomological Laboratory, Kamloops, British Columbia; British Museum (Natural History); Caucasus Parasitological Laboratory, Stavropol, U.S.S.R.; Robert Traub; E. W. Jameson; and miscellaneous private collections.

Remarks.—*P. mathesoni* and its usual host were rare above 9,000 feet altitude in the type locality.

This species is named for Professor Robert Matheson of the Department of Entomology, Cornell University, to whom I am deeply indebted.

Pleochaetis sibynus (Jordan). Plates 12, 13.

Ceratophyllus sibynus Jordan, Nov. Zool., **32**, p. 110, fig. 42, 1925.
Pleochaetis sibynes (sic) (Jordan), Nov. Zool., **39**, p. 77, 1933.
Pleochaetis sibynus, I. Fox, Jour. Sci., Iowa State College, **13**, p. 336, 1939.
Pleochaetis sibynus, Jellison and Good, Bull. Nat. Inst. Health, **178**, p. 125, 1942.
Pleochaetis sibynus, Ewing and Fox, Misc. Publ. U. S. Dept. Agric., **500**, p. 66, 1943.
Pleochaetis sibynus, Hubbard, Fleas of W. N. Amer., p. 246, 1947.

As shown below, *sibynus* has a wide distribution, but records are few and the female has heretofore been unknown. The species is characterized by the relatively short neck of the base of the aedeagus and by the movable finger, which

is broadened at the midpoint and possesses three stout marginal bristles apicad of the spiniform.

Resembling *P. mathesoni* sp. nov., except as indicated. Preantennal region of head with seven or eight bristles in irregular first row (pl. 12, fig. 1, male). Postantennal region with rows of bristles arranged 2(3)–4–4. Labial palpi (*L.P.*) extending about three-fourths of the length of the procoxae. Mesepisternum (*MPS.*) with four bristles near ventro-caudal angle. Metepimeron (*MPM.*) with nine bristles arranged 4–4–1. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	131	53	51	45	35	80
Meso-	210	90	74	58	42	80
Meta-	288	197	141	85	58	96

Abdominal terga with apical teeth arranged 2–2–2–1 in both sexes.

Modified Abdominal Segments: Male (pl. 12, fig. 3).—Eighth tergum with three small and three long dorso-marginal bristles, six median and two subventral bristles (pl. 12, fig. 2). Eighth sternum (*8 S.* and pl. 12, fig. 5) with six ventro-marginal bristles, a subapical bristle, and a long apical bristle; filamentous and tufted at apex.

Immovable process of clasper (*P.* and pl. 13, fig. 1) apically broadly rounded and with three short bristles; caudal margin somewhat incised below midpoint, evenly rounded ventrad of the two acetabular bristles. Movable finger (*F.* and pl. 13, fig. 1) with three stout mesal equally spaced bristles on dorso-caudal margin and with a much stouter mesal marginal bristle or subspiniform near midpoint of caudal margin; cephalic margin almost straight. Movable finger broadest in region of subspiniform and most proximal stout bristle; caudal margin rounded and curving cephalad near insertion of subspiniform.[1]

Distal arm of ninth sternum (*D.A.9* and pl. 13, fig. 2) with proximal lobe bearing two long bristles and three or four shorter bristles as illustrated.

Aedeagus of same general type as in *P. mathesoni* sp. nov. Base of aedeagus with a short neck (pl. 12, fig. 4, *N.*), only as long as wide. Lateral lobes (*L.L.*) somewhat narrower, apical margin more sinuate. Crochets (*CR.*) broad, width three-fifths of length from peg to apex in region of peg-like sclerotization; sides subparallel, apex somewhat rounded. Apex of sclerotic inner tube (*A.S.I.*) expanded, acuminate cephalad; apical margin mildly sinuate.

Modified Abdominal Segments: Female (pl. 13, fig. 3).—Seventh sternum (*7 S.*) with dorsal margin shallowly concave and with a small angled sinus on caudal margin. Seventh sternum with a row of one short and four long bristles preceded by five small bristles. Eighth tergum (*8 T.*) with six or seven fairly long medio-ventral bristles and five or six small, more cephalic ones. Spermatheca (*SP.* and pl. 13, fig. 5) with head three-fifths as broad as long, narrowed apically; tail almost as broad as head and subequal in length. Anal stylet (pl. 13, fig. 4) three times as long as wide.

Allotype.—A female (described above) from Mount Tancítaro, near the municipality of Tancítaro, State of Michoacán, Mexico. Collected at 10,000

[1] Dr. Jordan has pointed out (in litt.) that in the type male from Arizona, the slender bristles of the movable finger are less than one third the thickness of the stout one. In the Mexican specimens here described, the thickness is at least one half. He also stated that the apex of the immovable process is more triangular in the type. In a later letter, received subsequent to the preparation of the above description, Dr. Jordan wrote that he believes the Mexican specimens represent a distinct subspecies. In addition to the reasons noted, he pointed out that in the Arizona type, the median dorsal lobe of the aedeagus is longer and more curved, resembling that of *mathesoni*.

feet altitude, July 19, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Peromyscus melanotis* Allen and Chapman.

Records.—United States: Arizona: Paradise, ex "skunk" (holotype male); Grand Canyon, June, 1942, ex *Peromyscus maniculatus rufinus* Merriam (Hubbard, loc. cit.). I consider the New Mexico specimen referred to by Hubbard to represent a new subspecies of *P. equatoris* (Jordan).

Mexico: A long series, same host and locality as the allotype, collected at 9,000–11,200 feet altitude by Robert Traub (a few specimens from *Microtus mexicanus phaeus* Merriam); Ojo de Agua, Galeana (not "Craleano"!), Nuevo Leon (ex "*Peromyscus*"), and Cerro Potosi, Nuevo Leon, 12,500 feet altitude (ex "*Microtus*"), collected July and August, 1938, by the First Hoogstraal Biological Expedition to Mexico (I. Fox, loc. cit.).

Pleochaetis parus sp. nov. Plates 14, 15.

Near *P. sibynus* (Jordan) but separated as follows: Preantennal region of head with three rows of bristles. Mesepimeron with six, not eight, bristles. Movable finger with caudal border evenly rounded for entire length and with thinner marginal long bristles. Male ninth sternum with only four bristles (one small) on proximal lobe, not six. Male eighth tergum with only four, not eight, median bristles. Neck of aedeagus much longer, more than three times as long as wide, not subequal in length and width; sclerotized inner tube only feebly expanded cephalad. Female lacking a sinus on seventh sternum. The following description will serve to separate this species from *mathesoni* sp. nov.

Preantennal region with seven bristles in first row, three longer ones in second and third rows (pl. 14, fig. 1, male). Postantennal region with three bristles in first row. Labial palpi (*L.P.*) extending more than three-fourths the length of the procoxae. Mesepimeron (*MPM.*) with bristles arranged 2–2–2. Lateral metanotal area with three caudal bristles, one small. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	67	67	51	38	85
Meso-	250	107	103	67	41	90
Meta-	306	250	163	100	54	103

Male abdominal terga with apical teeth arranged 2–2–2–2; in female, 2–2–2–1. Male abdominal sterna two to six with three long bristles preceded by one or two small hairs; female with four long bristles preceded by two or three small hairs.

Modified Abdominal Segments: Male (pl. 14, fig. 3).—Eighth tergum (pl. 14, fig. 2) with six dorso-marginal bristles and four long median ones; produced in a short lobe at dorso-caudal angle. Eighth sternum (pl. 14, fig. 4) with sclerotized portion of base narrow and triangular; long and narrow, with four short thin ventral bristles and a long apical bristle; apical half of dorsal margin membranous and frayed.

Immovable process of clasper (*P.* and pl. 15, fig. 1) broad, apically rounded, and with three small bristles, sharply incised and arcuate ventrad of midpoint of caudal margin, becoming convex in the vicinity of the two acetabular bristles. Movable finger (*F.* and pl. 15, fig. 1) semilunar, with cephalic border straight except for short angle near midpoint; caudal border evenly convex, with three long stout marginal mesal bristles on apical half and a

much stouter bristle or subspiniform at midpoint. Distal arm of ninth sternum (*D.A.9* and pl. 15, fig. 2) with four marginal bristles on proximal lobe, the two most proximal bristles the longest, the second most apical very much the shortest.

Aedeagus of same general type as *P. mathesoni* sp. nov.; base with neck (pl. 14, fig. 5, *N.*) three times as long as wide. Crochets (*CR.*) with apex truncate; dorsal margin straight; ventral margin very shallowly concave. Apex of sclerotic inner tube (*A.S.I.*) flat, hardly extended proximad. Lateral sclerotization of sheath of inner tube (*L.S.I.*) well developed, although armature of sheath apparently represented only by a slight acuminate projection at midpoint of cephalic margin.

Modified Abdominal Segments: Female (pl. 15, fig. 3).—Seventh sternum (*7 S.*) with dorso-caudal margin concave, caudal margin evenly convex; apparently with a caudal row of six bristles (the most dorsal bristle small, the remainder long) preceded by a row of three small bristles, with two or three more cephalic small hairs near ventral margin. Ventral portion of eighth tergum (*8 T.*) with two median bristles, three ventro-marginal bristles and five marginal or submarginal caudal ones. Spermatheca (*SP.* and pl. 15, fig. 4) with head subovate, narrowed apically, less than twice as long as broad; tail almost as wide as and longer than head and with apical half curved over head. Anal stylet (pl. 15, fig. 5) more than twice as long as wide.

Holotype.—A male from Mount San Miguel, 6,500 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico; collected July 31, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Peromyscus hylocetes* Merriam.

Allotype.—A female, same data and depository as the holotype.

Paratype.—A female, same data as the holotype, in the collection of Robert Traub.

Pleochaetis equatoris equatoris (Jordan). Plate 16.

Ceratophyllus equatoris Jordan, Nov. Zool., **38**, p. 344, figs. 63 (male), 64 (female), 1933.
Pleochaetis equatoris Jordan, Nov. Zool., **39**, p. 77, 1933.

This species has not been reported since the original description. Through the kindness of Dr. Karl Jordan, the paratype female (the only female known) has been made available to me, and the following description and the figures are based upon study of this specimen; the drawing of the male genitalia, however, is after Jordan; the quotations are from the original description.

"Close to *C. apollinaris* J. and R. 1921, of which only the female is known. The female of the new species differs in the upper lobe of VII St. being much broader and rounded." Separated from *P. sibynus* (Jordan), *mathesoni* sp. nov. and *parus* sp. nov. by the fact that the spiniform on the movable finger is inserted far apicad of the midpoint.

Preantennal region with six small bristles in first row and three long bristles in ocular row (pl. 16, fig. 1, female). Postantennal region with bristles arranged 3–5–7. Labial palpi (*L.P.*) extending three-fourths of the length of the profemora. Mesepisternum (*MPS.*) with four small median and two larger caudal bristles. Mesepimeron (*MPM.*) with six bristles in two rows of three each.

Modified Abdominal Segments: Male (pl. 16, fig. 3).—"The VIII t. strongly rounded, bearing 6 or 7 dorsomarginal bristles, of which the 2 or 3 distal ones are long, and in addition

6 long lateral bristles of which one is ventral. VIII st. long and narrow, about one-eighth shorter than first hindtarsal segment, convex beneath, nearly straight above, pointed, ventrally with a pair of short bristles each in middle and at apical fourth, and a longer pair before apex. Bay above manubrium of clasper evenly rounded, parabolical, not semicircular; manubrium measured on upper side from deepest point of bay as long as clasper measured from the same point to the posterior margin above the acetabular bristles. Dorsal margin of clasper (*CL.*) incurved, this bay flatter; process *P.* irregularly triangular, being somewhat convex on the posterior side; upper acetabular bristle on a level of the lowest point of the anterior margin of the exopodite *F.* Angle of anterior margin of exopodite in middle of margin, the exopodite from this point upwards about twice as wide as in lower half; opposite the angle of the anterior margin, at the beginning of the widened portion, a large spiniform, above this anterior margin, slightly incurved, then strongly rounded and running obliquely upward-forward, forming with the anterior margin an acute apical angle, the tip of which is a little bent frontad; at the curve of the posterior margin 2 strong bristles about half the width of the large one below them, and farther upward a paler bristle, thinner and shorter. Apical portion of vertical arm of IX st. but little dilated; ventral sclerite narrow to point of division at one-third, then ventrally slightly rounded-dilated, this antemedian portion bearing about 10 bristles, of which the 2 ventral distal ones are long, but pale; the apical lobe of the ventral arm dorsally as long as the rest of the sclerite, convex above, broadest about middle, at apex more rounded ventrally than dorsally."

Modified Abdominal Segments: Female (pl. 16, fig. 4).—Seventh sternum (*7 S.*) bilobed, "divided by a narrow sinus into two rounded lobes, of which the lower one is much the broader." Seventh sternum with a row of six long bristles preceded by four small hairs. Eighth tergum (*8 T.*) with four subventral bristles, and six along the ventro-caudal margin. Ventral anal lobe (*V.A.L.*) with three stout curved bristles. Spermatheca (*SP.* and pl. 16, fig. 2) with head about "half the length of the tail, somewhat abrupt at the juncture with the tail."

Records.—Ecuador: "Quebrada of Pichan, west side of Pichincha, on *Sigmodon* sp., 4 II. 1932, 1 male, type (in Rothschild collection of British Museum —R.T.); Paramo de Guamani, on road to Baiza, Region Oriental, on *Oryzomys* sp., 27 VII 1931, 1 female."

Remarks.—A single male found in the collections of the United States National Museum and collected in New Mexico resembles Jordan's figure of *equatoris* in the shape of the movable finger. It is apparently quite different in other respects and is here considered a new subspecies.

Pleochaetis equatoris asetus subsp. nov. Plate 17.

Pleochaetis sibynus Hubbard, Fleas of W. N. Amer., p. 246, 1947 (in part, err. det., not Jordan 1925).

Separated from *P. e. equatoris* (Jordan) and from *mathesoni* sp. nov. and its allies in that the proximal lobe of the distal arm of the ninth sternum lacks the typical long marginal bristles. The new subspecies also has a long subapical bristle on the eighth sternum in addition to the long apical one, and has three lateral or median bristles. The apical lobe of the distal arm of the ninth sternum is ovate and dilated, not narrowed as in *e. equatoris.* The following description stresses differences from *mathesoni.*

Preantennal region with six or seven bristles in first row, including the very reduced ones near the antennal groove (pl. 17, fig. 1). Postantennal region with bristles 2–3–4.

Labial palpi (*L.P.*) about three-fourths of the length of the procoxae. Mesepimeron (*MPM.*) apparently with six or seven bristles. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	109	45	45	42	34	71
Meso-	202	80	77	58	38	77
Meta-	262	192	109	71	48	88

Abdominal terga with apical teeth arranged 2–2–1–1. Abdominal sterna three to six with three bristles.

Modified Abdominal Segments: Male (pl. 17, fig. 2).—Eighth tergum (pl. 17, fig. 4) with five long and two short dorso-marginal bristles, and three median and one lateral bristle. Eighth sternum (*8 S.* and pl. 17, fig. 7) ventrally convex, dorsally straight, and apically rounded, not pointed or membranous or frayed; three short ventral bristles, one long subapical bristle and one long apical one.

Immovable process of clasper (*P.* and pl. 17, fig. 6) broad and rounded, with two apical bristles; caudal margin apically convex, proximally concave to insertion of acetabular bristles and then again becoming convex. Movable finger (*F.* and pl. 17, fig. 6) of same general shape and chaetotaxy as in *e. equatoris* but caudo-apical margin more rounded, and cephalo-apical lobe not so acute and not directed cephalad. Most proximal stout marginal bristle equidistant between second and spiniform.

Distal arm of ninth sternum (*D.A.9* and pl. 17, fig. 5) with apical lobe ovate, much more dilated than proximal lobe, and with about four very small bristles on cephalic margin, four or five subapical, five or six on caudal margin and a few median. Proximal lobe of distal arm with one subapical very small bristle and two longer proximal submarginal ones; two smaller ones proximal of lobe proper. Long stout marginal bristles completely lacking.

Aedeagus (pl. 17, fig. 8) of same general type as that of *mathesoni*, but penis rods not fully coiled; base with neck (*N.*) slightly more than four times as long as wide. Crochets (*CR.*) not adequately visible, but apparently truncate and with straight sides. Sclerotic inner tube with apex (*A.S.I.*) flat and slightly acuminate at each end; proximally curved cephalad. Armature of sheath of inner tube (*A.I.T.*) apparently represented by a rounded cephalic expansion.

Holotype.—A unique male from "Mogollon Mountains," New Mexico, collected September 1, 1933, by H. S. Gentry. In the collection of the United States National Museum. Host: "*Callospermophilus lateralis arizonensis* and *Microtus mexicanus mogollonensis*" (the latter the more probable).

Pleochaetis dolens dolens (Jordan and Rothschild). Plates 18, 19.

Ceratophyllus dolens Jordan and Rothschild, Nov. Zool., **21**, p. 257, figs. 1, 2, 1914.
Pleochaetis dolens Jordan, Nov. Zool., **39**, p. 77, 1933.

A very short series of specimens from Guatemala and another from El Salvador agree with the figures and description of this species. Although showing some variation from the above as well as between themselves, they are herein described as *dolens*. Unless otherwise specified, the description below refers to specimens from El Salvador.

Preantennal region of head (pl. 18, fig. 1, male) with bristles arranged in an irregular first row of eight small bristles, a second row of two longer bristles, and an ocular row of

three yet longer bristles. Postantennal region with bristles 3–4–5. Labial palpi (*L.P.*) extending about seven-eighths of the length of the procoxae. Mesepisternum (*MPS.*) with two small median bristles and three caudo-marginal longer ones. Mesepimeron (*MPM.*) with six bristles in two rows of three. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	70	70	58	48	96
Meso-	259	122	77	73	51	102
Meta-	368	288	192	115	67	112

Abdominal terga with apical teeth 2–2–2–1. Male sterna with three long bristles preceded by a few very small ones; female with four similar small ones.

Modified Abdominal Segments: Male (pl. 18, fig. 3).—Eighth tergum (pl. 18, fig. 4) with seven dorso-marginal bristles (the first very small), one submarginal bristle, and four median and one ventral bristle. Guatemalan male slightly different (pl. 18, fig. 2). Eighth sternum (*8 S.* and pl. 18, fig. 5) long and narrow, with five small thin bristles on the somewhat convex ventral margin, and with a long subapical bristle; dorsal margin somewhat membranous and frayed for distal fourth.

Immovable process of clasper (*P.* and pl. 19, fig. 1) fairly broad, rounded, with three small apical bristles; caudal margin rounded (slightly incised near midpoint in Guatemalan specimen, pl. 19, fig. 2). Movable finger (*F.* and pl. 19, fig. 1) proximally narrowed, rapidly broadening, although cephalic margin straight for distal two-thirds except for apical acute extension; caudal margin strongly curving cephalad distad of midpoint, at level of apex of immovable clasper and at insertion of stoutest and most proximal marginal mesal long bristle; three somewhat thinner but similar bristles distad of above-mentioned stout bristle and proximal of apical fifth. Guatemalan male (pl. 19, fig. 2) with movable finger more sinuate, with cephalic border proportionately broader, and with distances between bases of marginal bristles subequal.

Distal arm of ninth sternum (*D.A.9* and pl. 19, fig. 3) with apical lobe hardly more dilated than ventral lobe, and with scattered very short bristles as in figure, most of them marginal. Proximal lobe of distal arm with four marginal bristles, the most proximal three the longest. Guatemalan male (pl. 19, fig. 4) with apical lobe more dilated than proximal; only two long and about six short thin marginal bristles on proximal lobe.

Aedeagus (pl. 18, fig. 6) of same general type as *P. mathesoni;* base with neck (*N.*) about twice as long as wide. Lateral lobes (*L.L.*) with ventral margin shallowly convex; caudal margin fairly straight; ventro-caudal angle rounded. Median dorsal lobe (*M.D.L.*) dorsally flattened. Crochets (*CR.*) with straight sides, somewhat apically narrowed; apex subtruncate. Sclerotic inner tube with apex (*A.S.I.*) truncate, expanded, extended cephalad, and acuminate; armature of sheath curved, acuminate, extending dorsad.

Modified Abdominal Segments: Female (pl. 19, fig. 5).—Seventh sternum (*7 S.*) with dorsal margin concave; caudal margin sinuate, the sinus subventral and shallow; a row of five long bristles preceded by five short bristles in an irregular row. Eighth tergum (*8 T.*) with two long bristles ventral to sensilium, two marginal bristles dorsad of caudal sinus (one at midpoint), one submarginal bristle near ventral border of caudal sinus, and six subventral bristles, of which three are submarginal. Spermatheca (*SP.* and pl. 19, fig. 7) with head subovate, about three-fifths or two-thirds as broad as long, dorsal margin slightly convex, ventral margin slightly concave; tail longer than, and almost as broad as head, and with an apical sclerotized papilla. Anal stylet (pl. 19, fig. 6) about three times as long as broad. Guatemalan females virtually the same as the El Salvador specimens.

Records.—Costa Rica: Irazu, 2,800 feet altitude (type locality, one pair, types not designated), from *Guerlinguetus hoffmani* Thomas. Collected by O. Garlepp.

El Salvador: Department of Santa Ana; two pairs from *Sciurus variegatoides bangsi* Dickey. Collected for the University of California, April 16, 1942, by M. Hildebrand.

Guatemala: Tecpam, Chimaltenango; one male from *Glaucomys goldmani* Nelson, February 5, 1934, and two females from *Orthogeomys grandis* Thomas, February 2, 1934. Collected by F. J. W. Schmidt on the Field Museum–Leon Mandel Guatemala Expedition.

Pleochaetis dolens quitanus (Jordan). Plate 20, figs. 1–3.

Ceratophyllus dolens quitanus Jordan, Nov. Zool., **37**, p. 136, figs. 2–4, 1931.

Separated from *P. d. dolens* by Jordan mainly because the male ninth sternum has four or five long bristles instead of three (cf. above) and the female seventh sternum has a more rounded lateral lobe. The following description is based upon that of Jordan and upon study of two paratype females made available through the kindness of Dr. Jordan.

Preantennal region usually with three rows of bristles, but variations in number and arrangement noted by Jordan. Paratype with these bristles arranged as in pl. 20, fig. 1. Mesepisternum (*MPS.*) apparently with four bristles in rows of 2–2, preceded by scattered small hairs. Mesepimeron (*MPM.*) with six bristles.

Proximal lobe of distal arm of ninth sternum with four or five long bristles, "on right side the second bristle much thinner and shorter than the four others."

Female with caudal margin of seventh sternum (*7 S.*, pl. 20, fig. 3) lacking a lobe or sinus and with a caudal row of five or six long bristles, preceded by six or seven much smaller ones in two irregular rows. Eighth tergum (*8 T.*) much like typical form. Spermatheca (*SP.* and pl. 20, fig. 2) of same type; duct "rather wide, and the blind duct branches off from it at about one-fifth, not emanating directly from the bursa copulatrix."

Records.—Ecuador: "Cerro de Puntas, off *Oryzomys* spec., 1 male (type), 1 female, and off *Thomasomys* spec., 2 females; Chimborazo, off *Thomasomys* spec., 1 female. Also a male in coll. Caroll Fox with 4 bristles on (ninth sternum), from near Quito."

Pleochaetis apollinaris (Jordan and Rothschild). Plate 20, figs. 8–13.

Ceratophyllus apollinaris Jordan and Rothschild, Ectoparasites, **1**, p. 176, figs. 163, 164, 1921.

This species is known only from the two female types. Dr. Jordan has graciously made one available for study.

The species is distinct from all others known to me in that while the head of the spermatheca is distinct, it is scarcely wider than the tail and the latter is much longer than the head. The species is also unique in that the female seventh sternum bears an acuminate dorsal lobe and a broader, rounded, ventral lobe.

Preantennal region (pl. 20, fig. 8) with two rows of bristles (7–3). Postantennal bristles 2–2 to 4–5. Labial palpi about three-fourths of the length of the procoxae. Mesepisternum (*MPS.*) with three or four very small bristles near cephalic margin, two slightly longer median bristles and two longer caudal ones. Mesepimeron (*MPM.*) with outlines obscured in specimen but apparently with seven bristles, four near ventral margin. Lateral metanotal area seemingly with five bristles, but probably two or three are in reality on mesepimeron. Metepimeron with seven or eight bristles. Abdominal terga with apical teeth 1(2)–2–2–2(1).

Seventh sternum (*7 S.*, pl. 20, fig. 9) divided by a narrow sinus, forming a dorsal acuminate lobe and a broad rounded ventral lobe (variations shown in pl. 20, figs. 10, 11; after Jordan); a row of five long bristles preceded by three smaller ones. Eighth tergum (*8 T.*) with two long bristles ventrad to sensilium and about twelve subventral bristles as shown in figure. Head of spermatheca (*SP.* and pl. 20, fig. 12) somewhat longer than broad, very much shorter than tail, which is nearly as wide as head.

Records.—Colombia: Savannah of Bogotá, from *Mustela affinis*, May, 1917, collected by Rev. Father Apollinaire Marie.

Pleochaetis vermiformis sp. nov. Plate 20, figs. 4–7.

Near *P. apollinaris* but separated from it and from all other known species by the characteristic vermiform spermatheca, which is of uniform thickness for most of its length and in which the head is not clearly demarcated. The chaetotaxy of the preantennal region of the head is also distinctive. This species may actually represent a distinct genus or subgenus.

Preantennal region with three rows of bristles arranged 5(irregular row)–4–3, with an accessory ventral long bristle in a line with bristle nearest eye (pl. 20, fig. 4). Postantennal region with bristles arranged 5–6(7)–5, not counting the accessory bristle near ventrocaudal angle (typical of females of at least this group of genera). Bristles of antennal club very short, extending distad of second annulation. Labial palpi about seven-eighths of the length of the procoxae. Mesepisternum (*MPS.*) with four bristles. Mesepimeron (*MPM.*) with six bristles in two rows of three. Abdominal terga with apical teeth 2–2–1–1. Abdominal sterna two to six with three long bristles preceded by two very small bristles near ventral margin and one dorsad of bases of long bristles.

Seventh sternum (*7 S.*, pl. 20, fig. 7) with dorso-caudal margin shallowly concave; caudal margin with a dorsal shallow sinus, rounded ventrad of sinus; four long bristles preceded by three much smaller ones. Eighth tergum (*8 T.*) with two long bristles ventral to sensilium and with eleven lateral ventral marginal and submarginal ones as shown in figure. Spermatheca (*SP.* and pl. 20, fig. 5) of uniform diameter throughout most of its length; U-shaped with apical arm longer and apically subacuminate; head not clearly demarcated but apparently constituting most or all of more truncate, shorter arm. Anal stylet (pl. 20, fig. 6) slightly more than twice as long as wide.

Holotype.—A female from the Department of Chalatenango, El Salvador; collected for the University of California, March 22, 1942, by M. Hildebrand. In the collection of the United States National Museum. Host: "*Peromyscus*" sp.

Remarks.—A female from Santa Elena, Chimaltenango, Guatemala, 10,000 feet altitude, collected from *Peromyscus guatemalensis* Merriam, January 26, 1934, by F. J. W. Schmidt, agrees closely with the above description. The spermatheca is vermiform but is mounted in such a way that it cannot be properly studied.

The following species of *Pleochaetis* s. str. are in the second group, which is characterized by the possession of apical spiniforms or a single stout bristle on the subclavate movable finger, by beak-shaped crochets, and by penis rods that are not coiled like a spring.

Pleochaetis paramundus sp. nov. Plates 21, 22.

Distinct from all known *Pleochaetis* in the reduced chaetotaxy of the postantennal region of the head—only one bristle is represented in the first row, and two or three in the second. Near *mundus* (Jordan and Rothschild 1922), but further separated by the following: The most ventral spiniform of the movable finger more proximal, inserted near apical fourth, not apical sixth; eleven or twelve (instead of eight) non-marginal bristles on eighth tergum; sclerotized portion of inner tube extending apicad for a distance greater than size of end-chamber, instead of half its size; head of spermatheca shorter than tail instead of longer.

Preantennal region with two rows of bristles (pl. 21, fig. 1, male), the first row of seven bristles, including three small ones near antennal groove. Postantennal bristles arranged 1–2(rarely 3)–4. Labial palpi subequal to length of procoxae. Pronotal comb with about eight spines on a side. Mesepisternum (*MPS.*) with thin scattered median and cephalo-marginal small bristles and three longer caudo-marginal ones. Mesepimeron (*MPM.*) with eight bristles arranged 2–3–3. Lateral metanotal area with two or three median bristles. Metepimeron with eight bristles arranged 4–3–1 or nine arranged 3–2–3–1. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	144	48	51	42	38	83
Meso-	217	106	96	64	42	93
Meta-	320	240	160	105	61	99

Abdominal terga with apical teeth arranged 1–1–1–0 in both sexes, some specimens apparently without any on some segments.

Modified Abdominal Segments: Male (pl. 21, fig. 3).—Eighth tergum (pl. 21, fig. 2) with three dorso-marginal bristles and twelve other bristles, only one of which is ventral, arranged as in figure. Eighth sternum (*8 S.* and pl. 21, fig. 5) long and narrow; three short thin ventral bristles, a much longer subapical one, and a still longer apical bristle; dorsal margin proximally concave, apically slightly convex and extending into a short subacuminate lobe distad of apical bristle.

Immovable process of clasper (*P.* and pl. 22, fig. 1) with sides subparallel; apically subtruncate and sinuate; two short thin bristles at cephalo-dorsal angle; caudal margin produced into a rounded lobe bearing the two acetabular bristles. Movable finger (*F.* and pl. 22, fig. 1) subclavate, with apex shallowly convex and twice as broad as proximal portion; cephalic and caudal margins widening fairly evenly from base to apex, but caudal margin becoming straight at insertion of long mesal spiniform near distal fourth; another mesal spiniform, less than half as long, at dorso-caudal angle, with a thin, marginal bristle dorsal and ventral of this spiniform; cephalo-dorsal angle scarcely produced cephalad.

Ninth sternum (*D.A.9* and pl. 22, fig. 2) with proximal lobe of distal arm about twice as long as wide and bearing about eight relatively short thin bristles; apical lobe long and curved caudad; cephalic margin strongly convex; apical margin shallowly convex;

caudal margin proximally straight and at apical third becoming markedly concave; marginal bristles relatively short and thin, arranged somewhat as follows: two on cephalic margin, one or two apical, one near caudal sinus, four subproximal, one proximal.

Aedeagus (pl. 21, fig. 4) of a somewhat different type than in *P. mathesoni* and allies. Apodeme (*AE.A.*) long and narrow, more than seven times as long as wide; ventral and dorsal margins subparallel for much of their length; with an apical spur only slightly longer than maximum width of apodeme. Base of aedeagus proper with a short neck (*N.*) slightly broader than long. Expanded endchamber about twice width of aedeagal apodeme. Median dorsal lobe (*M.D.L.*) simple and curved dorsally but truncate at apex. Lateral lobes (*L.L.*) ovate, covering base of aedeagus. Accessory lateral lobes (*A.L.L.*) arising near base of median dorsal lobe, long and highly acuminate. Crochets (*CR.*) well developed, almost equal to vertical diameter of endchamber; dorsal margin strongly convex but excised at proximal third, forming a shallow sinus; ventral margin strongly convex distad of peg-like sclerotization, making apex of crochet beak-shaped (pl. 22, fig. 2). Apex of sclerotic inner tube (*A.S.I.*) narrow and proximally recurved, greatly extended distally as a sclerotized curved narrow band (*B.I.T.*), reaching ventrally of ventral margin of lateral lobe. Armature of inner tube not apparent; lateral sclerotization of sheath (*L.S.I.*) apparently continued ventrad proximad of base of crochets and ventrad of penis rods; membranous portion not evaginated, unlike the preceding species. Penis rods (*P.R.*) not coiled, extending only slightly cephalad of spur of aedeagal apodeme, proximal portion much thickened. Ventral intramural rod of endophallus (*I.R.*) well developed. Apodemal strut consisting of a dorsal acuminate lobe (*D.S.*), a median somewhat acuminate mesal lobe (*M.S.*) and a lateral ventral curved lobe (*L.S.*). Crescent sclerite (*C.S.*) broader than in *P. mathesoni.*

Modified Abdominal Segments: Female (pl. 22, fig. 3).—Seventh sternum (*7 S.*) with dorso-caudal margin concave; caudal margin with a deep narrow median sinus forming a subtruncate broad dorsal lobe and a subequal more rounded ventral lobe. Some specimens, with same data and otherwise virtually indistinguishable, lacking the caudal sinus and with entire caudal margin subtruncate (pl. 22, fig. 5). Seventh sternum with a row of five small thin bristles followed by a row of six much longer ones. Eighth tergum (*8 T.*) with two long bristles ventrad to sensilium and with bristles on ventral portion as follows: three small bristles nearest to seventh sternum, a row of three and a row of four longer bristles (including marginals), one bristle dorsal and two ventral of shallow caudal margin sinus; two mesal small thin bristles near ventral anal lobe. Anal stylet (pl. 22, fig. 6) about twice as long as wide. Ventral anal lobe (*V.A.L.*) with three short bristles, the shortest two at the cephalo-ventral angle. Spermatheca (*SP.* and pl. 22, fig. 4) with head subovate, dorsal margin convex, ventral margin somewhat sinuate; tail somewhat longer than head and proximally almost as wide as head; apical portion marginally thickened and with an apical sclerotized papilla.

Holotype.—A male from Mount Tancítaro, at 10,200 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico. Collected July 24, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Neotomodon alstoni* Merriam (a rat resembling the woodrat).

Allotype.—A female, same data and depository as the holotype.

Paratypes.—One male and five females, same data as the holotype. In the collections of the United States National Museum, the Rocky Mountain Laboratory at Hamilton, Montana, the San Francisco Plague Laboratory, and Robert Traub.

Remarks.—This species is interesting not only *per se,* but because the head chaetotaxy is suggestive of the genus *Monopsyllus* Kolenati. It is not known

whether the reduction of bristles is a primitive condition or a modification. The genitalia are very much like those of *P. mundus*, which in turn somewhat resemble the *Monopsyllus* type, more so than the species previously discussed. The host of this new species is apparently rather rare and found in a relatively restricted area, possibly suggesting primitive features in its ectoparasites.

Pleochaetis mundus (Jordan and Rothschild). Plates 23, 24.

Ceratophyllus mundus Jordan and Rothschild, Ectoparasites, **1**, p. 272, fig. 266 (male only), 1922.

Pleochaetis mundus Jordan, Nov. Zool., **39**, p. 77, 1933.

Pleochaetis mundus, Dampf, Rev. Soc. Mex. Hist. Nat., **3**, p. 135, pls. 21–23, 1942 (allotype designated and described).

This species, the genotype, until recently was known only from the original collection. However, in 1942 Dampf described the allotype female and fully redescribed the male, superbly illustrating the characters mentioned. The following description is based upon specimens collected in Michoacán, Mexico, and stresses differences from *P. paramundus* sp. nov.

P. mundus is characterized by the insertion of the long spiniform at the apical sixth of the movable finger; by the apical width of the movable finger (three or more times proximal width), by the apex of the sclerotic inner tube being almost doubled upon itself; by the relatively short distal band of the sclerotized inner tube; and by the broadly pointed dorsal lobe of the female seventh sternum.

Preantennal region of head (pl. 23, fig. 1, male) with two rows of bristles, the first row of seven bristles so irregular that it may appear like two rows, the second or ocular row with the typical three long bristles, of which the middle is the shortest. Postantennal bristles arranged 2–4–5. Mesepisternum (*MPS.*) with two caudal bristles. Mesepimeron (*MPM.*) with six bristles arranged 3–3. Metepimeron bristles arranged 2–3–1. Measurements of male tibiae and tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	61	58	45	38	80
Meso-	234	122	99	66	38	83
Meta-	340	256	163	102	58	93

Abdominal terga with apical teeth arranged 2–2–2–2 in male, 2–2–2–1 in female.

Modified Abdominal Segments: Male (pl. 23, fig. 3).—Eighth tergum (pl. 23, fig. 2) with about four dorso-marginal bristles, three subdorsal marginal, three median, and two ventral, of which one is much longer than the other. Eighth sternum (*8 S.* and pl. 23, fig. 6) proximally an acute triangle, then long and narrow, with about five short, very thin ventro-marginal bristles and three long subapical ones; an apical membranous subacute expansion.

Immovable process of clasper (*P.* and pl. 24, fig. 1) with apical margin truncate; two thin bristles at cephalo-dorsal angle and another somewhat displaced caudad; caudal margin deeply concave apicad of insertion of the acetabular bristles, becoming convex at that insertion. Movable finger (*F.* and pl. 24, fig. 1) apically more than three times width of proximal portion; cephalic margin angled at midpoint and produced cephalad at angle with

straight apical margin; caudal margin curving caudad for about five-sixths of its length; at apical sixth a long mesal submarginal spiniform; a spiniform about one-third as long inserted at apico-caudal angle; a still smaller spiniform proximad of apical one; three or four short thin bristles near apical margin and others near cephalic margin.

Ninth sternum much like that of *P. paramundus* in shape and chaetotaxy but proximal lobe of distal arm (*D.A.9* and pl. 24, fig. 2) hardly expanded, with four or five relatively short thin bristles; about five short thin marginal bristles on proximal part of cephalic lobe; distal portion of apical lobe relatively narrowed, with scattered short thin marginal and submarginal bristles.

Aedeagus (pl. 23, fig. 4) much like that of *P. paramundus*, but crochets (*CR.*) relatively larger, more than half of vertical diameter of endchamber; apex of sclerotic inner tube (*A.S.I.*) with proximal recurved portion extending almost as far distad as truncate apex proper, and with distal sclerotized band (*B.I.T.*) extending only to about level of penis rods.

Modified Abdominal Segments: Female (pl. 24, fig. 3).—Seventh sternum (*7 S.*) with a broad deep sinus so that it possesses a somewhat broadly pointed dorsal lobe and a smaller rounded or subtruncate ventral lobe; two rows of bristles, the first of four or five short thin ones, the second of five much longer ones. Eighth tergum (*8 T.*) with about six lateral ventral non-marginal and seven marginal bristles, as in figure. Anal stylet (pl. 24, fig. 5) about three times as long as broad. Spermatheca (*SP.* and pl. 24, fig. 4) subovate, slightly broader nearer tail than at extremity, slightly longer than tail which, in turn, is wide but not as wide as head and bears an apical papilla.

Records.—Mexico: Tacubaya (not "Facubaya"), from field mouse, "*Rato de campo*" (data in original description); Mexico, D. F., from *Peromyscus melanotis* Allen and Chapman, February, 1942 (Dampf); same locality, but no host data, December, 1944, collected by H. Wagner; Michoacán, municipality of Tancítaro, altitude 6,000 feet, from "mouse," collected by K. L. Knight of Third Hoogstraal Biological Expedition to Mexico, July 29, 1940; same locality, from nest of *Reithrodontomys c. chrysopsis* Merriam and from *Peromyscus hylocetes* Merriam, collected by Robert Traub, July, 1941.

Pleochaetis schmidti sp. nov. Plates 25, 26.

Near *P. paramundus* sp. nov. and *mundus* but separated as follows: Movable finger much narrower, less than twice as wide apically as proximally (pl. 26, fig. 1), not three or more times as wide; only a short bristle at dorso-caudal angle, small spiniforms lacking. Proximal lobe of distal arm of ninth sternum with long marginal bristles (pl. 26, fig. 2). Male eighth sternum (pl. 25, fig. 5) much shorter, from base to apex about three-fourths of length of distal arm of ninth sternum, not subequal. Female seventh sternum with a single broad apical lobe (pl. 26, fig. 3). Preantennal region with at least three distinct rows of bristles plus an additional ventral bristle. Postantennal region with three rows of bristles, as in *mundus*. The following description emphasizes differences from *paramundus*.

Preantennal region (pl. 25, fig. 1, male) with irregular anterior row of about nine or ten bristles; second row of three longer bristles; ocular row of three still longer bristles; a long single bristle along ventral margin midway between lowest bristle in second and ocular rows. Postantennal rows of bristles arranged 3–4–4(5). Labial palpi (*L.P.*) about three-fourths of length of procoxae. Mesepisternum (*MPS.*) with three or four median or

caudal bristles. Mesepimeron (*MPM.*) with six bristles in two rows of three. Lateral metanotal area with two or three bristles. Metepimeron with bristles arranged 2–3–2. Measurements of male tibiae and tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	177	67	67	45	45	90
Meso-	272	135	118	77	48	106
Meta-	358	284	211	132	77	112

Abdominal terga with apical teeth typically arranged 2–2–2–2 in male, 2–2–2–1 in female.

Modified Abdominal Segments: Male (pl. 25, fig. 3).—Eighth tergum (pl. 25, fig. 2) with twelve dorso-marginal or subdorsal bristles and one ventral bristle. Eighth sternum short, less than four times as long as wide near base, with two short subapical bristles and one small thin ventral bristle. Immovable process of clasper (*P.* and pl. 26, fig. 1) subconical, with two apical bristles; apical half of caudal margin straight, ventral half sinuate, the sinus originating at a prominent angle, the height of convexity at the insertion of the acetabular bristles. Movable finger (*F.* and pl. 26, fig. 1) subclavate, long, about twice the length of immovable process; proximal half with margins subparallel; cephalic margin with distal half shallowly concave; caudal border with distal half definitely convex and with about six thin short marginal bristles; a short mesal submarginal bristle, suggesting a spiniform, at dorso-caudal angle; apical margin straight except where curving caudad; apically about one and a half times as wide as proximally.

Proximal lobe of distal arm of ninth sternum (*D.A.9* and pl. 26, fig. 2) with four short thin proximal marginal bristles and three marginal long curved bristles, each associated with a long but thinner submarginal one. Apical lobe with cephalic margin strongly convex; ventral margin biconvex; proximally expanded, with three long thin marginal bristles; sinus broad and mildly sinuate, the apical convexity with about three submarginal short thin bristles. Apical lobe with scattered small bristles as in figure; the triangular sclerotization associated with proximal portion displaced more dorsad than in most *Pleochaetis*, not submarginal.

Aedeagus (pl. 25, fig. 4) much like that of *paramundus* and *mundus* but with neck (*N.*) narrower, longer than broad. Apex of sclerotized inner tube (*A.S.I.*) with proximal recurved area more at right angles, and with distal sclerotized band (*B.I.T.*) about as short as in *mundus* but with membranous portion (*E.I.T.*) extending far distad. Apodemal strut with three sclerites, as in *paramundus*, but median mesal lobe (*M.S.*) not acuminate, unlike *paramundus*. Crescent sclerite broader and shorter than in *mathesoni*. In this species the base of the aedeagus has a very deep sinus dorsad of the neck, while the ventral sinus or concavity proximad of the neck, characteristic of the other species, seems to be absent.

Modified Abdominal Segments: Female (pl. 26, fig. 3).—Seventh sternum (*7 S.*) with dorsal margin deeply concave; caudal margin dorsally a truncate lobe, ventrally sharply turned cephalad and slightly concave; a curved row of five long bristles preceded by four smaller bristles. Eighth tergum (*8 T.*) with two long and one short bristle ventrad to sensilium; ventral bristles consisting of three small median bristles and two longer subventral ones near two long marginal bristles, a small bristle ventrad of caudal marginal sinus and three longer ones at angle near ventral anal lobe. Anal stylet (pl. 26, fig. 5) somewhat more than twice as long as broad. Spermatheca (*SP.* and pl. 26, fig. 4) with head two-thirds as broad as long, broader near tail than at other extremity; slightly convex above; tail somewhat longer than width of head and about half as broad; apical papilla not developed.

Holotype.—A male from Volcan Tajumulco, Department of San Marcos, Guatemala. Collected February 27, 1934, by F. J. W. Schmidt on the Field

Museum–Leon Mandel Expedition to Guatemala. In the collection of Chicago Natural History Museum. Host: *Reithrodontomys* sp. (a harvest mouse).

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Several males and females, same data as the holotype; in the collections of the United States National Museum and Robert Traub.

Remarks.—This species is named for the collector, the late Franklin J. W. Schmidt, whose premature death cut short a promising career as a naturalist.

Comment on the Genus Pleochaetis

Some of the species of *Pleochaetis* seem to have a very wide distribution; for example, *dolens* is known from Ecuador, Costa Rica, El Salvador and Guatemala, and *equatoris* from Ecuador and New Mexico.

As shown previously, and as is borne out in the key below, the males fall into two distinct groups. However, the males of *vermiformis* sp. nov. and *apollinaris* are not yet known. The female of *equatoris asetus* subsp. nov. is unknown. The known forms are included in the following key. It is pointed out that only one character in the couplet need apply and it is not necessary to check each character mentioned.

KEY TO KNOWN SPECIES OF *PLEOCHAETIS*

1. Males 2
   Females 11

2. Movable finger with three or more marginal stout bristles (pl. 11, fig. 1), apical spiniforms absent; penis rods long, extending cephalad of aedeagus a distance almost equal to length of apodeme, usually coiled (pl. 10, fig. 4, *P.R.*); crochets (*CR.*) apically subtruncate, not acuminate; apical appendage (*AP.A.*) of apodeme long, about half or more the length of apodeme 3

   Movable finger with at most one marginal stout bristle (pl. 26, fig. 1), usually with apical spiniforms (pl. 24, fig. 1); penis rods extending cephalad of aedeagus a distance much less than length of apodeme (pl. 21, fig. 4, *P.R.*); crochets beak-shaped, apically acuminate (*CR.*); apical appendage (*AP.A.*) of apodeme less than one-fourth the length of apodeme 9

3. Distal arm of ninth sternum with proximal lobe lacking long curved bristles (pl. 17, fig. 5) ..... *equatoris asetus* subsp. nov. (p. 33)

   Distal arm of ninth sternum with proximal lobe bearing several long curved stout bristles (pl. 11, fig. 2) 4

4. Neck of aedeagus (pl. 12, fig. 4, *N.*) relatively short, about as broad as long; apex of sclerotized inner tube (*A.S.I.*) much expanded, cephalic portion of expansion greater than ventral curved margin of median dorsal lobe (*M.D.L.*); eighth tergum (pl. 12, fig. 2) with five or six median and two ventral lateral bristles. *sibynus* (Jordan 1925) (p. 29)

   Neck of aedeagus (pl. 10, fig. 4, *N.*) two or more times as long as broad; apex of sclerotized inner tube (*A.S.I.*) less expanded cephalad, less than ventral curved margin of median dorsal lobe (*M.D.L.*); eighth tergum (pl. 10, fig. 2) with five or fewer median bristles and only one ventral lateral bristle 5

5. Movable finger about three times as long as wide at maximum (pl. 11, fig. 1); stout marginal bristle near midpoint of movable finger three times the width of the three more apical bristles..... *mathesoni* sp. nov. (p. 26)

   Movable finger only about two and one-half times as long as wide at maximum (pl. 16, fig. 3); stout marginal bristle near midpoint of movable finger no more than twice the width of the three more apical bristles..... 6

6. Head with only two distinct rows of preantennal bristles (pl. 16, fig. 1); movable finger with apical half definitely wider than proximal half because of marked convexity of apical caudal margin (pl. 16, fig. 3)... *e. equatoris* (Jordan 1933) (p. 32)

   Head with three rows of preantennal bristles (pl. 14, fig. 1) or with first antennal row of bristles irregular, appearing as two rows (pl. 18, fig. 1); movable finger with caudal margin fairly evenly rounded (pl. 19, fig. 1)..... 7

7. Movable finger virtually semilunar (pl. 15, fig. 1), with stoutest marginal bristle or subspiniform at midpoint; apex of sclerotized inner tube (pl. 14, fig. 5, *A.S.I.*) with only a very slight acuminate cephalic expansion that is much less than half the width of the sclerotized inner tube..... *parus* sp. nov. (p. 31)

   Movable finger with proximal half of caudal margin more narrowed than apical half (pl. 19, fig. 1), with stouter marginal bristle distad of midpoint; apex of sclerotized inner tube (pl. 18, fig. 6, *A.S.I.*) with acuminate cephalic expansion well developed, about half as wide as sclerotized inner tube..... 8

8. Proximal lobe of distal arm of ninth sternum with four or five subequal long curved bristles..... *dolens quitanus* (Jordan 1931) (p. 36)

   Proximal lobe of distal arm of ninth sternum with two (pl. 19, fig. 4) or three or four, long bristles but one of four shorter (pl. 19, fig. 3).
   dolens dolens (Jordan and Rothschild 1914) (p. 34)

9. Movable finger less than twice as wide apically as proximally (pl. 26, fig. 1) and lacking apical small spiniforms; proximal lobe of distal arm of ninth sternum with long curved bristles (pl. 26, fig. 2)..... *schmidti* sp. nov. (p. 41)

   Movable finger two or more times as wide apically as proximally (pl. 22, fig. 1), apical small spiniforms present; proximal lobe of distal arm of ninth sternum lacking long curved bristles (pl. 22, fig. 2)..... 10

10. Movable finger with longest spiniform inserted at apical fourth (pl. 22, fig. 1); postantennal bristles reduced in number, 1–2(3)–4 (pl. 21, fig. 1); sclerotized band of inner tube (pl. 21, fig. 4, *B.I.T.*) extended distally as far as ventral margin of lateral lobes..... *paramundus* sp. nov. (p. 38)

    Movable finger with longest spiniform inserted at apical sixth (pl. 24, fig. 1); postantennal bristles arranged 2–4–5 (pl. 23, fig. 1); sclerotized band of inner tube (pl. 23, fig. 4, *B.I.T.*) extended distad only to level of penis rods.
    mundus (Jordan and Rothschild 1922) (p. 40)

11. Spermatheca vermiform, with head scarcely delimited from tail and of same width (pl. 20, fig. 5)..... *vermiformis* sp. nov. (p. 37)

    Spermatheca not vermiform, with head well separated from tail and at least wider proximally (pl. 20, fig. 2)..... 12

12. Head with postantennal bristles reduced in number, 1–2(3)–4 (pl. 21, fig. 1).
    paramundus sp. nov. (p. 38)

    Head with two or three bristles in first postantennal row and four in second row (pl. 20, fig. 1)..... 13

13. Seventh sternum with a fairly deep median sinus so that caudal margin is definitely bilobed (pl. 20, fig. 9) 14
Seventh sternum broadly rounded without a sinus (pl. 20, fig. 3), or with a broad shallow sinus so that caudal margin is slightly sinuate (pl. 13, fig. 3) 17

14. Dorsal lobe of seventh sternum broader than ventral lobe (pl. 24, fig. 3); head of spermatheca slightly longer than tail (pl. 24, fig. 4).
mundus (Jordan and Rothschild 1922) (p. 40)
Dorsal lobe of seventh sternum narrower than ventral lobe; head of spermatheca somewhat shorter than tail 15

15. Tail of spermatheca recurved over head, curve starting at base of tail, fairly appressed to head and much longer than head (pl. 20, fig. 12); preantennal region with two rows of bristles (pl. 20, fig. 8) 16
Tail of spermatheca at right angle to head, at least at origin, scarcely longer than head (pl. 11, fig. 4); preantennal region with first row of bristles irregular, appearing as two rows (pl. 10, fig. 1) ..... *mathesoni* sp. nov. (p. 26)

16. Dorsal lobe of seventh sternum acuminate and much narrower than ventral lobe (pl. 20, fig. 9) ..... *apollinaris* (Jordan and Rothschild 1921) (p. 36)
Dorsal lobe of seventh sternum rounded, almost as broad as ventral lobe (pl. 16, fig. 4) ..... *e. equatoris* (Jordan 1933) (p. 32)

17. Seventh sternum with a single broad lobe caused by sharp ventro-cephalad curve in margin (pl. 26, fig. 3) ..... *schmidti* sp. nov. (p. 41)
Seventh sternum with ventro-caudal margin evenly rounded or subtruncate (pl. 20, fig. 3) 18

18. Seventh sternum with caudal margin evenly convex (pl. 15, fig. 3) 19
Seventh sternum with a broad shallow sinus (pl. 13, fig. 3) or with a slight incision (pl. 11, fig. 8, in part) 20

19. Apical half of tail of spermatheca curved over head, extending over midpoint of head (pl. 15, fig. 4); bristles of seventh and eighth sterna as in pl. 15, fig. 3.
parus sp. nov. (p. 31)
Tail of spermatheca not curved over head (pl. 20, fig. 2); bristles of seventh and eighth sterna as in pl. 20, fig. 3 ..... *dolens quitanus* (Jordan 1931) (p. 36)

20. Head of spermatheca three-fourths as broad as long, with subparallel margins distad of constriction (pl. 11, fig. 4) ..... *mathesoni* sp. nov. (p. 26)
Head of spermatheca no more than two-thirds as broad as long, narrowed distally (pl. 19, fig. 7) 21

21. Seventh sternum with a subdorsal caudal sinus (pl. 13, fig. 3); head of spermatheca slightly more than half as broad as long (pl. 13, fig. 5); nine bristles on metepimeron, arranged 4–4–1 ..... *sibynus* (Jordan 1925) (p. 29)
Seventh sternum with a shallow sinus for almost entire caudal margin (pl. 19, fig. 5); head of spermatheca about two-thirds as broad as long (pl. 19, fig. 7); usually only seven bristles on metepimeron.
dolens dolens (Jordan and Rothschild 1914) (p. 34)

KOHLSIA gen. nov.

Genotype *Kohlsia osgoodi* sp. nov.

Near *Pleochaetis* Jordan 1933 (s. str.) but with short stout bristles or subspiniforms on the distal arm of the male ninth sternum; aedeagal apodeme

broader, apically rounded and lacking an apical appendage; base of aedeagus broad, not constricted, neck therefore absent; median dorsal lobe of aedeagus expanded, flared and convoluted, forming accessory lobes; crochets almost as broad as long or broader; and female anal stylet lacking the dorsal bristle.

Preantennal region of head with three or more rows of bristles, with four bristles in the penultimate row. Manubrium fairly long and narrow, apically about one-fourth (or less) as broad as cephalic margin of apodeme of ninth tergum. Male eighth tergum lacking ventral bristle. Proximal arm of ninth sternum with apex curved and acuminate. Movable finger with stout marginal bristles. Crochets finely reticulate, broad and subconical. Lateral lobes of aedeagus well developed, covering most of inner tube. Accessory lateral lobe present. Armature of sheath of inner tube well developed. Dorsal and/or ventral internal rod of endophallus often well sclerotized. Spermatheca subovate or more or less rounded. Ventral anal lobe of female with longish thin subspiniforms, not stout and recurved ones.

Remarks.—In this genus belong *Kohlsia graphis* (Rothschild 1909) and four new species described below. As defined, it also includes *K. campaniger* (Jordan 1931), but as Dr. Jordan points out (in litt.), the bursa copulatrix is of quite a different type, and when the male is known, it may prove to be generically distinct.

The genus is named for Glen M. Kohls of the Rocky Mountain Laboratory of the United States Public Health Service, who has contributed much to the study of ectoparasites.

Kohlsia osgoodi sp. nov. Plates 27, 28.

Near *K. graphis* (Rothschild 1909), but readily separated from it, and the other new species described below, by the fact that the movable finger bears four stout marginal bristles or subspiniforms (pl. 28, fig. 1), not three (pl. 30, fig. 1). Further separated from *graphis* by virtue of the following: The male eighth sternum has a small dorsal subapical bristle (pl. 27, fig. 5) but no ventral one (pl. 30, fig. 4); the proximal lobe of the distal arm of the male ninth sternum bears an apical spiniform (pl. 28, fig. 2) in addition to proximal ones (pl. 30, fig. 6); the median dorsal lobe of the aedeagus (pl. 27, fig. 4, *M.D.L.*) has a prominent ventral claw-like convolution (PS.L.); the armature of the sheath of the inner tube (*A.I.T.*) is of a very different type (cf. pl. 29, fig. 4, *A.I.T.* and descriptions); there is a long narrow accessory spur (*A.SP.*) arising near the origin of the accessory lateral lobe; the head of the spermatheca is longer than broad (pl. 28, fig. 5), not subspherical (pl. 29, fig. 2); the female seventh sternum has a short truncate median lobe (pl. 28, fig. 3); the preantennal region has more than eight bristles in the irregular first row.

Male and Female: Head (pl. 27, fig. 1, male).—Anterior margin evenly rounded, with frontal tubercle small but distinct. Preantennal region with three rows of bristles: The first with nine to eleven small bristles in a very irregular row, especially in male, in female only one or two bristles out of line; the second row with four longer bristles; the ocular row with three longer bristles of which the middle is the smallest. A series of very small setae along ventral border of antennal fossa and thinly scattered on gena. Eye conspicuous, subovate, well-pigmented. Genal process fairly broad, becoming acuminate. Maxillary lobe (*MX.*) extending to middle of fourth segment of maxillary palpus. Maxillary laciniae

(*LAC.*) about one-third of diameter of labial palpi, with apical half denticulate or microserrate. Labial palpi (*L.P.*) extending three-fourths the length of procoxae. Bristles of second antennal segment very short, scarcely reaching second annulation of club. A row of very small setae along dorsal margin of antennal fossa. Postantennal region with bristles arranged 3–5(6)–5(6) in male; female with an extra bristle at ventro-caudal angle.

Thorax.—With five long bristles preceding the nine or ten pronotal ctenidial spines on each side. Mesonotum with a row of bristles along dorsum but with four rows represented in lateral aspect, the first row very incomplete, the second of similar short hairs, the third of six or seven longer bristles and the fourth of four or five very long bristles. Mesonotum with three or four apical seta-like extensions suggesting thin apical spinelets. Mesepisternum (*MPS.*) with two median bristles (preceded by a few small hairs) and four caudal bristles. Mesepimeron (*MPM.*) with seven bristles arranged 1–3–3. Metanotum with three rows of bristles, the first incomplete. Metanotal flange with an apical small tooth on each side. Lateral metanotal area with two bristles, that in dorso-caudal angle twice the length of the median one. Metepisternum with one bristle in dorso-caudal angle. Metepimeron with seven bristles, often arranged 3–3–1.

Legs.—Profemora with about six small thin lateral median bristles; meso- and metafemora with one each. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	61	58	51	43	83
Meso-	260	122	99	70	48	83
Meta-	343	265	174	112	64	96

None of tarsal bristles reaching beyond apex of following segment. Distal tarsal segment of each leg with four pairs of lateral plantar bristles, basal pair slightly displaced medially. Blade of unguis about twice the length of thickened recurved basal portion.

Abdomen.—First tergum with three rows of bristles, the first row very incomplete. Male with apical small teeth on each side of abdominal terga as follows: one on first tergum, two on second, and one on each of third and fourth. Female with tergal teeth 2–2–1–1. Second row of bristles on terga two to six much longer than first row and usually extending somewhat ventrad of spiracles. One bristle on ventral margin of basal sternum. Sterna three to six usually with four ventro-marginal bristles, the most dorsal the shortest. Male with upper antepygidial bristle very small, about one-seventh (or less) the length of middle one; ventral bristle somewhat less than one-third the length of middle one (pl. 27, fig. 3, *A.B.*); female with ventral antepygidial bristle somewhat more than half the length of middle one; dorsal bristle definitely less than half the length of middle one (pl. 28, fig. 3, *A.B.*).

Modified Abdominal Segments: Male (pl. 27, fig. 3).—Eighth tergum large, covering most of genitalia, slightly spiculose caudad of sensilium, with three or four small dorso-marginal bristles and four dorso-median bristles, the last two long, as shown in pl. 27, fig. 2. Eighth sternum (*8 S.* and pl. 27, fig. 5) long and narrow, somewhat longer than proximal portion of distal arm of ninth sternum, with a long subapical bristle and a much smaller subdorsal bristle; ventral bristles lacking. Intersegmental membrane (*I.M.*) between eighth and ninth segments somewhat enlarged and spiculose in vicinity of proximal lobe of distal arm of ninth segment.

Immovable process of clasper (*P.* and pl. 28, fig. 1) broadly rounded; apical portion broader than movable finger, apically with three short thin bristles; caudal margin straight except for shallow subapical sinus and slight convexity at the insertion of the two acetabular bristles. Movable finger (*F.* and pl. 28, fig. 1) scarcely extending distad of immovable process; less than three times as long as broad; cephalic and caudal margins subparallel

for most of their length; caudal margin with four short stout mesal bristles or subspiniforms, the four equally spaced and the fourth smaller and inserted near ventro-caudal angle; two or three short thin bristles on cephalic margin, and two more apicad and a longer one between second and third subspiniforms. Ventral margin of apodeme of ninth tergum (*T.AP.9*) subequal to cephalic margin of manubrium (*MB.*). Subpygidial sclerite of Wagner apparently not developed.

Ninth sternum very well developed, somewhat V-shaped because of flexion in distal arm. Proximal arm (*P.A.9*) subequal in length to distal arm (*D.A.9*); apical third or fourth with cephalic margin concave, the remainder of ventral margin straight; dorsal margin shallowly concave proximally; apically convex so that apex of proximal arm suggests crooked finger, the crooked portion about three times as long as broad at middle. Distal arm of ninth sternum (*D.A.9* and pl. 28, fig. 2) with a proximal caudal convexity or lobe and a median cephalic convexity; apically oblong. Proximal lobe of distal arm with three marginal spiniforms, two proximal and one apical, and with about ten thin lateral and submarginal bristles; three shorter spiniforms on caudal margin near apex of distal arm and thin bristles in a row or scattered, as in figure.

Aedeagal apodeme (pl. 27, fig. 4, *AE.A.*) somewhat less than twice the length of aedeagus proper but more than three times as long as broad; dorsal margin slightly sinuate. Proximal spur (*P.S.*) present. A somewhat similar accessory spur (*A.SP.*) arising from base of tongue-like, proximally broad, acuminate accessory lateral lobe (*A.L.L.*) at base of aedeagus. Median dorsal lobe (*M.D.L.*) greatly flared apically, convoluted, forming a primary median dorsal lobe (*P.M.D.*), a secondary or paradorsal lobe (*P.D.L.*) and an acuminate, somewhat curved, pseudo-ventral lobe (*PS.L.*). Lateral lobes (*L.L.*) ventrally and caudally evenly rounded, extending dorsad to subdorsal lobe. Crochets (*CR.* and pl. 28, fig. 2) subconical, almost as broad as long, ventrally strongly concave; proximo-ventrally associated with delicate, membranous, tufted, filamentous, acuminate microprojections; ventro-apically extended into two or three curved acuminate fang-like projections. Armature of sheath of inner tube (*A.I.T.*) with caudal margin ventrally subglobose, cephalic margin biconvex, the proximal projection extending proximo-cephalad. Apex of sclerotic inner tube (*A.S.I.*) often appearing biconvex and winged due to distal extension of penis rod, actually only with cephalic expansion markedly acuminate and convex. Membranous inner tube apparently not extending distad. Apodemal strut supporting inner tube consisting of a broad subquadrate submedian mesal lobe (*M.S.*) and a large latero-ventral curved lobe (*L.S.*). The longer member of penis rods about twice the length of aedeagal apodeme. Ventral (*I.R.*) and dorsal (*D.I.R.*) intramural rods of endophallus relatively well sclerotized.

Tenth abdominal segment conspicuous; sensilium fairly flat; dorsal lobe of proctiger (*D.L.P.*) with a dorsal fringe of bristles, subtriangular; ventral lobe (*V.L.P.*) of proctiger almost three times as long as broad, with about four long apical or subapical bristles preceded by a row of much smaller bristles. Proximal ventral sclerite represented by subtriangular dark area.

Modified Abdominal Segments: Female (pl. 28, fig. 3).—Seventh sternum (*7 S.*) with a conspicuous, narrow, short, blunt lobe on caudal margin and with four long bristles preceded by one or two much shorter ones. Eighth tergum (*8 T.*) with two long bristles ventral to sensilium, five long subventral bristles, and three or four bristles by caudo-marginal sinus. Eighth sternum (*8 S.*) about four times as long as broad. Anal stylet (pl. 28, fig. 6) somewhat more than twice as long as broad at base; ventral bristle at apical fourth, more than one-third the length of apical bristle; a minute vestige of dorsal bristle. Ventral anal lobe (*V.A.L.* and pl. 28, fig. 4) angulate; extended apicad and acuminate at dorso-caudal angle; three fairly stout bristles near ventro-caudal angle, these subequal at base to the long apical bristles and not recurved. Spermatheca (*SP.* and pl. 28, fig. 5) with head more than three-fifths as broad as long; dorsal margin convex, ventral margin shallowly biconvex; tail longer than head.

Holotype.—A male from Santa Elena, Department of Chimaltenango, Guatemala. Collected at 10,000 feet altitude, January 26, 1934, by F. J. W. Schmidt on the Field Museum–Leon Mandel Expedition to Guatemala. In the collection of Chicago Natural History Museum. Host: *Peromyscus guatemalensis* Merriam.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Five males and seven females, same data as the holotype. In the collections of the United States National Museum, the Rocky Mountain Laboratory (Hamilton, Montana), the San Francisco Plague Laboratory, the Dominion Entomological Laboratory (Kamloops, British Columbia), the British Museum (Natural History), and Robert Traub.

Remarks.—This species is named for F. L. Osgood of Rutland, Vermont, who has done much to advance the study of ectoparasites.

Kohlsia graphis (Rothschild).

Ceratophyllus graphis Rothschild, Nov. Zool., **16**, p. 62, pl. 10, figs. 3, 4, 1909.

This species has been discussed briefly in the comparison with *K. osgoodi* sp. nov. Important characteristics are:

About seven bristles in first row of preantennal region (pl. 29, fig. 1); crochets (pl. 29, fig. 4, *CR.*) with narrowed acuminate distal projections, but these not bifid; apex somewhat bifid, not pointed. Median dorsal lobe (*M.D.L.*) of aedeagus bifid, but ventral claw-like convolution absent. Armature of sheath of inner tube (*A.I.T.*) of aedeagus with an acuminate cephalad-projecting sclerotization. Without an accessory spur near accessory lateral lobe of aedeagus. Movable finger with three marginal equidistant subspiniforms. Male eighth sternum with one or two apical bristles and one ventral marginal bristle. Spermatheca (pl. 29, fig. 2) subspherical; tail much longer than head. Female seventh sternum (pl. 30, fig. 3, *7 S.*) lacking a lobe.

There are two subspecies known:

Kohlsia graphis erana subsp. nov. Plates 29, figs. 1–5; 30, figs. 1–4.

Separated from typical form in that the distal arm of the male ninth sternum is apically narrowed (pl. 30, fig. 2), not subtruncate (pl. 30, fig. 6); caudal margin of female seventh sternum apparently much less oblique (pl. 30, fig. 3), about 80 degrees from horizontal, not about 60 degrees. The following description stresses differences from *K. osgoodi* sp. nov.

Head (pl. 29, fig. 1, male).—Preantennal bristles arranged 7–4–3; postantennal bristles 3–5(4)–5. Labial palpi extending almost to apex of procoxae, mesonotum with three rows of bristles, the first incomplete. Mesepisternum (*MPS.*) with one or two bristles near caudal margin. Metanotum with four rows of bristles, the first two incomplete. Metepimeron with seven to nine bristles. Measurements of male tibiae and tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	192	77	77	64	48	96
Meso-	278	150	128	80	48	96
Meta-	430	320	208	128	64	109

Male abdominal terga with apical spinelets arranged 1–2–2–1; in female, 1–1–1–1. Abdominal sterna three to six with three or four bristles.

Modified Abdominal Segments: Male (pl. 29, fig. 3).—Eighth tergum with two relatively short and two long bristles near dorsal margin, and one short and one long median bristle; margins indistinct. Eighth sternum (*8 S.* and pl. 30, fig. 4) about three times as long as broad at base, with one or two apical bristles and a median bristle (sometimes also a ventral one) on apical fourth.

Immovable process and movable finger of clasper (*P.* and *F.* and pl. 30, fig. 1) of same general shape as in *K. osgoodi.* Movable finger (*F.*) with three equidistant mesal subspiniforms on caudal margin, but none ventral; about twice as long as broad at level of middle subspiniform; extending distad almost as far as immovable process. Ventral margin of apodeme of ninth tergum (*T.AP.9*) much shorter than cephalic margin of manubrium.

Distal arm of ninth sternum (*D.A.9* and pl. 30, fig. 2) with two or three marginal subspiniforms on proximal convexity and with three apical small subspiniforms; cephalic margin sharply curving caudad from below level of lowest apical subspiniform; thin bristles as in figure.

Aedeagus (pl. 29, fig. 4) of same general type as that of *osgoodi.* Median dorsal lobe (*M.D.L.*) with a single convolution, resulting in a rounded paradorsal lobe (*P.D.L.*) extending almost as far apicad as primary median dorsal lobe (*P.M.D.*). Crochets (*CR.*) shaped like a cone with a subtruncate sinuate apex, about four-fifths as broad as long; cephalic margin less concave than dorsal and ventral margins; ventral margin with a very narrow acuminate projection at apical fifth. Tufted filamentous membranous microprojections apparently not fully associated with crochets (probably restricted to intersegmental membrane between eighth and ninth segments). Armature of sheath of inner tube (*A.I.T.*) fairly well developed; ventral margin subtruncate; cephalic margin deeply concave, with squarish sides with an acuminate sclerotization pointing cephalo-dorsad. Lateral sclerotization of inner tube (*L.S.I.*) well developed as a lobe extending dorso-caudad. Apex of sclerotic inner tube (*A.S.I.*) truncate, sides curved and subparallel.

Modified Abdominal Segments: Female (pl. 30, fig. 3).—Seventh sternum (*7 S.*) with dorso-caudal margin straight and then becoming concave; caudal margin straight, almost perpendicular; a row of six long bristles (third somewhat smaller) preceded by a small one near ventral margin. Eighth tergum (*8 T.*) with three long bristles (dorsalmost half the length of others) ventral to sensilium; subventral bristles arranged 4–3–1, not counting two pairs of small mesal bristles ventrad to ventral anal lobe; four caudo-marginal bristles. Anal stylet (pl. 29, fig. 5) about three times as long as broad at base. Spermatheca (*SP.* and pl. 29, fig. 2) with head subglobular; only slightly longer than broad; tail about twice the length of head, curved, about half the width of head at entrance, more dilated at proximal third than apically or proximally.

Holotype.—A male from Department of Santa Ana, El Salvador. Collected for the University of California, April 23, 1942, by M. Hildebrand. In the collection of the United States National Museum. Host: *Peromyscus* sp.

Allotype.—A female, same locality and depository as the type. Collected April 22, 1942, by M. Hildebrand and J. T. Marshall. Host: *Sciurus d. deppei* Peters (probably the true host).

Paratype.—A female, same data as the allotype. In the collection of the San Francisco Plague Laboratory.

Kohlsia graphis graphis (Rothschild 1909). Plates 29, fig. 6; 30, figs. 5–7.

Examination of two paratype males, lent by Dr. Jordan, reveals that the distal arm of ninth sternum is apically subtruncate, the apex curving cephalad just

proximad of level of middle subspiniform (pl. 30, fig. 6); male eighth tergum with four or five bristles. The original description states that the "apical edge of the (female) seventh sternite is very oblique." The original figure shows that the caudal margin makes an angle of about 60 degrees with the horizontal.

The two paratypes are variable regarding the number of mesepimeron bristles (8 and 7), metepimeron bristles (8 and 7), number of bristles on eighth sternum (two on a side as in pl. 30, fig. 7, or with an additional subdorsal one), and arrangement of marginal stout bristles on movable clasper (as in pl. 30, fig. 5, or with middle bristle nearer dorsal).

It is interesting to note how closely the aedeagal endchamber, as drawn (pl. 29, fig. 6) from specimens mounted nearly forty years ago, resembles that of the El Salvador subspecies.

Known only from the original record: "Nicaragua (no further data), taken off *Sciurus deppiei* (sic) and received from Mr. W. F. H. Rosenberg."

Kohlsia gammonsi sp. nov. Plate 31.

This interesting new species is among the excellent material from El Salvador received for study through the kind co-operation of Dr. Frank M. Prince of the United States Public Health Service.

Near *K. osgoodi* sp. nov. and *graphis* (Rothschild) but distinct in that the preantennal region of the head (pl. 31, fig. 1) has more than 20 bristles, often in five rows; the proximal lobe of the male distal arm (pl. 31, fig. 6) is very prominent, subequal to the width of the distal arm at that point; the median dorsal lobe of the aedeagus (pl. 31, fig. 4, *M.D.L.*) is trebly convoluted; the armature of the sheath of the inner tube (*A.I.T.*) is extended dorso-caudad as a beak-like extension; the crochets (*CR.*) are conical and lack fang-like extensions. The male eighth sternum is relatively broader, with ventro-marginal bristles. The female seventh sternum has an acute dorsal lobe like that of *osgoodi*, but the spermatheca is more like that of *graphis*.

Preantennal region in male with five rows of bristles arranged 3–6–5–5–3; in female 7(irregular row)–7–4–3. Labial palpi about three-fourths of length of procoxae. Postantennal bristles usually 4–5–5. Mesepisternum (*MPS.*) with two submedian and two caudal bristles. Mesepimeron (*MPM.*) with eight bristles. Metepimeron with six bristles arranged 2–3–1. Measurements of male tibiae and tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	144	61	51	42	38	77
Meso-	224	115	96	61	38	80
Meta-	315	256	160	102	58	90

Male abdominal terga with apical teeth 1–2–1–1; in female, 1–1–1–1. Male abdominal sterna usually with three bristles, in female usually with four, of which most dorsal is shortest. Female with tergum projecting somewhat between bases of antepygidial bristles.

Modified Abdominal Segments: Male (pl. 31, fig. 3).—Eighth tergum apparently with only four bristles, three long and one short. Eighth sternum (*8 S.* and pl. 31, fig. 5) broader

subapically than proximally, apically somewhat rounded, lacking the typical long apical bristle, but with five ventral bristles, the most apical two longest, the ultimate one subapical.

Immovable process (*P.* and pl. 31, fig. 9) and movable finger (*F.*) much like that of *osgoodi* but lacking the ventral subspiniform and with the three mesal caudo-marginal subspiniforms nearer the middle. Movable finger with caudal margin evenly rounded; somewhat less than three times as long as broad at middle.

Proximal arm of ninth sternum (*P.A.9*) with curved apex only about twice as long as broad at middle. Distal arm (*D.A.9* and pl. 31, fig. 6) with a very pronounced proximal lobe on caudal margin, the lobe as broad as the rest of distal arm at this point and bearing three marginal short subspiniforms; cephalic margin sinuate, the sinus subapical; apex somewhat narrowed and truncate and bearing three short marginal subapical subspiniforms. Distal arm with scattered thin bristles as in figure.

Aedeagus (pl. 31, fig. 4) of same general type as that of *osgoodi*. Median dorsal lobe (*M.D.L.*) sinuate proximally, trebly convoluted, forming a well-extended primary median dorsal lobe (*P.M.D.*), a shorter primary paradorsal lobe (*P.D.L.*), and a still shorter secondary paradorsal lobe. Accessory lateral lobe (*A.L.L.*) proximally very broad. Accessory spur (*A.SP.*), at base of accessory lateral lobe, fairly straight. Crochets (*CR.*) conical, as broad as long, with shallowly concave ventral margin. Armature of sheath of inner tube (*A.I.T.*) conspicuously extended dorso-caudad as narrow, curved, acuminate projections; proximo-cephalic margin with a sinus; proximo-caudal margin straight; apex of sclerotized inner tube (*A.S.I.*) reduced to a small acuminate projection along cephalic border of curve of armature of inner tube. Dorsal intramural rod of endophallus feebly sclerotized.

Modified Abdominal Segments: Female (pl. 31, fig. 8).—Seventh sternum (*7 S.*) with an acuminate short dorso-caudal lobe; caudal margin ventrad of sinus mildly sinuate, more than five times as broad as dorsal lobe. Seventh sternum with a row of six long bristles, preceded by two small ventral bristles. Eighth tergum (*8 T.*) with five subventral lateral bristles (one of which is short), not counting the three at ventro-caudal angle. Spermatheca (*SP.* and pl. 31, fig. 7) with head about three-fourths as broad as long, dorsal margin convex, ventral margin fairly straight; tail almost twice as long as head, more than half as broad, curved so that apical axis is at right angles to proximal axis. Anal stylet (pl. 31, fig. 2) somewhat less than three times as long as broad near base.

Holotype.—A male from Department of Chalatenango, El Salvador. Collected for the University of California, March 25, 1942, by M. Hildebrand. In the collection of the United States National Museum. Host: *Peromyscus* sp.

Allotype.—A female, same data and depository as the holotype, but collected March 24, 1942.

Paratype.—A female, same data as the allotype. In the collection of the San Francisco Plague Laboratory.

Remarks.—This very interesting species is named for Mr. Gray Gammons of the Army Medical Department Research and Graduate School, who has helped me immeasurably in this study.

Kohlsia uniseta sp. nov. Plate 32.

Unique in that immovable process bears only one acetabular bristle. Near *K. gammonsi* sp. nov., but otherwise separated by the following: median dorsal lobe of aedeagus (pl. 32, fig. 5, *M.D.L.*) bifid, the lobes almost equal; accessory lateral lobe (*A.L.L.*) very narrow proximally; armature of sheath of inner tube

(*A.I.T.*) with a narrow acuminate caudal projection; accessory aedeagal spur lacking; distal arm of ninth sternum (pl. 32, fig. 4) without prominent proximal lobe; female seventh sternum lacking apical lobe. Separated from *osgoodi* and *graphis* by the absence of fang-like projections on the crochets. The following description stresses differences from *osgoodi*.

Head (pl. 32, fig. 1, male).—Bristles of preantennal region very variable, arranged 5(tiny)–6–4–3 in one male, 7(irregular)–5–4 in another, 7–5–3 in a third; females usually 7–4–3. Labial palpi (*L.P.*) extending more than three-fourths of length of procoxae. Postantennal region with bristles 4–5–5. Mesepisternum (*MPS.*) with one submedian and two caudal bristles. Mesepimeron (*MPM.*) usually with six bristles arranged 3–3, at times with seven. Metepimeron with seven or eight bristles. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	61	58	45	35	83
Meso-	246	112	96	67	45	83
Meta-	320	256	177	106	61	96

Male abdominal terga with apical teeth arranged 1–2–2–1; female, 1(2)–2–1–1. Male sterna three to six usually with three bristles; female with four, of which most dorsal is shortest.

Modified Abdominal Segments: Male (pl. 32, fig. 3).—Eighth tergum apparently with five subdorsal or median lateral bristles of which three are long. Eighth sternum (*8 S.* and pl. 32, fig. 6) apically narrow, with two long apical bristles and a long dorso-marginal bristle on each side.

Immovable process (*P.* and pl. 32, fig. 2) and movable finger (*F.*) much like that of *osgoodi* but with only one acetabular bristle and with ventral marginal subspiniform lacking. Movable finger with caudal margin evenly rounded, extending virtually as distad as immovable process.

Distal arm of ninth sternum (*D.A. 9* and pl. 32, fig. 4) with proximo-caudal margin somewhat convex, but definite lobe lacking, the proximal convexity with three short subspiniforms; cephalic margin with a convex flange-like margin extending to subapical portion; apical portion almost as broad as rest of distal arm; two short subapical subspiniforms near caudal margin and scattered thin bristles as in figure.

Aedeagus (pl. 32, fig. 5) of same general type as that of *osgoodi*. Median dorsal lobe (*M.D.L.*) cleft or bifid, with resulting paradorsal lobe (*P.D.L.*) fairly broad and extending about three-fourths as far distad as primary median dorsal lobe (*P.M.D.*). Crochets (*CR.*) somewhat limpet-shaped, apex biconvex, about one-fourth of diameter of sinuate base; cephalic margin concave, oblique proximally; caudal margin shallowly concave. Armature of sheath of inner tube (*A.I.T.*) expanded as a long acuminate projection or spur pointing caudad at the level of the proximally thin accessory lateral lobe (*A.L.L.*), with a thin but well sclerotized sinuate girdle, suggesting carabao horns, ventrad to the above spur; proximal portion broad and rounded, curving ventro-cephalad. Apex of sclerotized inner tube (*A.S.I.*) slightly sinuate or subtruncate, with angles somewhat sharp and expanded.

Modified Abdominal Segments: Female (pl. 32, fig. 8).—Seventh sternum (*7 S.*) with dorso-caudal margin concave; caudal margin with a slight dorsal sinus, the remainder fairly straight; a row of six long bristles. Eighth tergum (*8 T.*) with seven long subventral lateral bristles arranged 5–2; four caudo-marginal bristles; four or five shorter mesal bristles, two of which are very short and thin. Spermatheca (*SP.* and pl. 32, fig. 7) with head slightly

longer than broad, dorsal and ventral margins convex; tail elbowed, much longer than head, proximal portion slightly more than half as broad as head. Anal stylet (pl. 32, fig. 9) somewhat more than twice as long as broad near base, at times with one to three minute supernumerary hairs.

Holotype.—A male from Department of Santa Ana, El Salvador. Collected for the University of California, April 22, 1942, by M. Hildebrand. In the collection of the United States National Museum. Host: *Peromyscus* sp.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Two males and three females, same data as the holotype. In the collections of Chicago Natural History Museum, the San Francisco Plague Laboratory, and Robert Traub.

Remarks.—The name was suggested by the fact that the male clasper has only one acetabular bristle.

Kohlsia cora sp. nov. Plate 33, figs. 1–4, 6–7.

This species, of which only the male is known, is near *K. uniseta* sp. nov., but the clasper has two (not one) acetabular bristles. Other differences are: distal arm of ninth sternum with but one apical subspiniform (not two) and with two distal contiguous subspiniforms on proximal convexity (pl. 33, fig. 3) instead of well-separated ones. Aedeagus (pl. 33, fig. 4) with a very short primary paradorsal lobe (*P.D.L.*) and equally short secondary paradorsal lobes instead of a single paradorsal lobe that is subequal in length to the median dorsal lobe; a well-developed accessory lateral lobe (*A.L.L.*); ventral margin of crochet (*CR.*) evenly concave, not doubly sinuate; apex of sclerotized inner tube (*A.S.I.*) truncate; armature of inner tube (*A.I.T.*) without acuminate processes. Eighth sternum (pl. 33, fig. 7) with a subapical ventral bristle.

Head (pl. 33, fig. 1, male).—With preantennal bristles arranged 7–4–3. Labial palpi (*L.P.*) about seven-eighths of length of procoxae. Postantennal bristles 4–5–5. Mesepisternum (*MPS.*) with three fairly short bristles. Mesepimeron (*MPM.*) with seven bristles arranged 2–3–2. Metepimeron with seven bristles arranged 2–4–1. Measurements of male tibiae and tarsal segments:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	63	58	48	36	83
Meso-	240	115	90	61	42	83
Meta-	330	256	166	96	58	99

Abdominal tergal teeth arranged 1–2–2–1. Sterna three to six with three bristles.

Modified Abdominal Segments: Male (pl. 33, fig. 2).—Eighth tergum with apparently five subdorsal or median lateral bristles, of which one is short. Eighth sternum (*8 S.* and pl. 33, fig. 7) very narrow, with a long apical bristle and two smaller subapical bristles, one apparently submedian, the other ventro-marginal.

Immovable process (*P.* and pl. 33, fig. 6) and movable finger (*F.*) much like that of *osgoodi* but with ventral marginal subspiniform lacking and with movable finger broader, about twice as long as broad at level of most ventral marginal stout bristle. Caudal margin of movable finger strongly convex; cephalic margin angled at apical fifth.

Distal arm of ninth sternum (*D.A.9* and pl. 33, fig. 3) with caudal margin sinuate but with resulting proximal convexity less than one-third of diameter of distal arm at this level; proximal convexity with three short curved subspiniforms, one at base of convexity and the other two contiguous and apical; apical portion of distal arm somewhat narrower than proximal, with a short subapical subspiniform; thin bristles scattered on distal arm as in figure; cephalic margin with a conspicuous flange-like margin that curves caudo-apicad at apical eighth of distal arm.

Aedeagus (pl. 33, fig. 4) of same general type as that of *osgoodi*. Median dorsal lobe (*M.D.L.*) medially convoluted, forming a primary paradorsal lobe (*P.D.L.*)—that extends apicad only about one-half or two-thirds as much as the primary median dorsal lobe (*P.M.D.*)—and an equally short secondary paradorsal lobe. Crochets (*CR.*) shaped somewhat like an equilateral triangle with concave sides, the cephalic margin the most concave, the caudal the least, and the ventral proximally almost straight (the crochets are pivoted strongly dorsad in the specimen, and the well-developed rounded lateral lobes at first glance appear to be the crochets). Accessory lateral lobe (*A.L.L.*) well developed proximally but rapidly becoming acuminate. Armature of sheath of inner tube (*A.I.T.*) well developed as a massive curved sclerite arising distad of apodemal struts supporting inner tube and then curving cephalad to base of accessory lateral lobe; lacking acuminate projections. Apex of sclerotic inner tube (*A.S.I.*) broad and truncate; lateral margins squared at apex, equally curved proximally.

Holotype.—A unique male from Department of Morazan, El Salvador. Collected for the University of California, December 29, 1941, by M. Hildebrand. In the collection of the United States National Museum. Host: *Peromyscus* sp.

Kohlsia campaniger (Jordan). Plate 33, fig. 5.

Ceratophyllus campaniger Jordan, Nov. Zool., **37**, p. 143, fig. 12, 1931.

This species is known to me only from the original description, which was based on a single female. As I previously pointed out, Dr. Jordan (in litt.) states that the bursa copulatrix is of a unique type and that when the male is found it may prove that the species belongs in a separate genus.

This species can apparently be readily recognized by the bell-shaped duct of the spermatheca; no other known species of *Kohlsia* has such a duct. The seventh sternum is also fairly straight in *graphis* and *gammonsi*, but in these species the seventh sternum bears six long bristles, not five. Furthermore, the other species have only two or three large bristles ventrad to sensilium, not four.

"Close to *C. graphis* Roths. 1909. As in that species the frons and occiput with three rows of bristles, the proboscis reaching to the end of the forecoxae; the bristles on antennal segment II short; on mesonotum numerous small bristles from the posterior row to the base; bristles above stigma of VIII. t. numerous; those of anal sternite long and slender. Differs in the apical margin of VII. st. being much less slanting [pl. 33, fig. 5, after Jordan], in VIII. t. bearing 4 large bristles below stigma and in the sexual organs: while the spermatheca is practically the same as in *C. graphis*, its duct begins with a large, bell-shaped, thick-walled, swelling which is longer than broad, being longer than head of spermatheca." (Original description.)

Records.—"Ecuador (no more precise locality given), one (female) found by the late Oldfield Thomas on a spirit specimen of *Hesperomys* (coll. Frazer) in the British Museum."

Comment on the Genus Kohlsia

Although this genus is reported only from *Peromyscus* and *Sciurus* in Ecuador and Central America, it probably parasitizes various small rodents in northern South America and in Central America, and probably occurs also in Mexico.

The movable finger and immovable process of the clasper is of fairly uniform structure in the known species. However, the aedeagus shows many and interesting modifications from a fundamental pattern. The male ninth sternum is an important taxonomic aid in the group. While there are at times striking differences in the head chaetotaxy, it should be noted that individuals of the genus tend to be variable regarding the general chaetotaxy, although all species seem to possess more bristles than even those of *Pleochaetis* s. str.

In the key to the species that follows, it should be borne in mind that the female of *cora* is not yet known, while *campaniger* is known only from the female. In the case of the males, only *one* character listed in a couplet need apply. It is difficult to find characters for the females that are as clear-cut, hence all the characters listed should be checked.

KEY TO KNOWN SPECIES OF *KOHLSIA*

1. Males 2
   Females 7
2. Movable finger with four stout marginal bristles or subspiniforms including one near ventral margin (pl. 28, fig. 1); median dorsal lobe of aedeagus with a prominent ventral claw-like convolution (pl. 27, fig. 4, *PS.L.*) ..... *osgoodi* sp. nov. (p. 46)
   Movable finger with three marginal stout bristles or subspiniforms, none ventral (pl. 30, fig. 1); aedeagus convoluted, but ventral curved claw-like lobe absent ... 3
3. Eighth sternum (pl. 31, fig. 5) with more than two ventro-marginal bristles in addition to subapical or apical ones; distal arm of ninth sternum with a very pronounced proximal lobe, as broad as rest of arm at this level (pl. 31, fig. 6); armature of inner tube of aedeagus (pl. 31, fig. 4, *A.I.T.*) extended dorso-caudad as long beak-like projection ..... *gammonsi* sp. nov. (p. 51)
   Eighth sternum with only one (or no) ventro-marginal bristle (pl. 30, fig. 4); distal arm of ninth sternum proximally somewhat convex but lobe never equal to width of arm at this level (pl. 30, fig. 2); armature of inner tube not extended as beak-like projection 4
4. Immovable process of clasper with only one acetabular bristle (pl. 32, fig. 2); armature of inner tube of aedeagus (pl. 32, fig. 5, *A.I.T.*) with an acuminate caudad-directed spur ..... *uniseta* sp. nov. (p. 52)
   Immovable process of clasper with two acetabular bristles (pl. 30, fig. 5); armature of inner tube without a caudal spur (pl. 29, fig. 4, *A.I.T.*) 5
5. Aedeagal crochets (pl. 29, fig. 4, *CR.*) with an acuminate fang-like ventral projection(s); paradorsal lobe of aedeagus (*P.D.L.*) straight; secondary paradorsal lobe absent; distal arm of ninth sternum (pl. 30, fig. 2) with two or three subapical short stout bristles or subspiniforms 6
   Aedeagal crochets (pl. 33, fig. 4, *CR.*) lacking fang-like projections; primary (*P.D.L.*) and secondary paradorsal lobes present, convex; distal arm of ninth sternum (pl. 33, fig. 3) with only one short subapical subspiniform ..... *cora* sp. nov. (p. 54)

6. Apex of distal arm of ninth sternum curved and oblique, curving caudad somewhat proximad of level of most proximal subspiniform (pl. 30, fig. 2). *graphis erana* subsp. nov. (p. 49)
   Apex of distal arm subtruncate, curving caudad slightly apicad of level of most proximal subspiniform (pl. 30, fig. 6)..... *graphis graphis* (Rothschild 1909) (p. 50)
7. Duct of spermatheca with a large, bell-shaped, thick-walled swelling (pl. 33, fig. 5); four large bristles ventral to sensilium..... *campaniger* (Jordan 1931) (p. 55)
   Spermatheca with duct lacking a bell-shaped, thick-walled swelling; only two or three large bristles ventral to sensilium..... 8
8. Seventh sternum with a pronounced but acute dorsal lobe on caudal margin (pl. 31, fig. 8)..... 9
   Seventh sternum at most with a shallow subdorsal sinus (pl. 30, fig. 3) or straight, true lobe lacking..... 10
9. Preantennal region with four distinct rows of bristles; seventh sternum with five or six subequal long bristles (pl. 31, fig. 8, *7 S.*)..... *gammonsi* sp. nov. (p. 51)
   Preantennal region with three rows of bristles but first row may have one or two bristles out of line (pl. 27, fig. 1); seventh sternum with four subequal long bristles and one or two shorter ones (pl. 28, fig. 3, *7 S.*)..... *osgoodi* sp. nov. (p. 46)
10. Tail of spermatheca more dilated at curve than elsewhere (pl. 29, fig. 2); abdominal tergal teeth 1–1–1–1..... 11
    Tail of spermatheca no broader at curve than elsewhere (pl. 32, fig. 7); abdominal tergal teeth 1(2)–2–1–1..... *uniseta* sp. nov. (p. 52)
11. Seventh sternum with caudal margin very oblique, making an angle of about 60 degrees with horizontal..... *graphis graphis* (Rothschild 1909) (p. 50)
    Seventh sternum with caudal margin almost perpendicular, making an angle of about 80 degrees with horizontal (pl. 30, fig. 3, *7 S.*).... *graphis erana* subsp. nov. (p. 49)

DESCRIPTIONS OF NEW CERATOPHYLLID FLEAS FROM MEXICO

The species of *Foxella* are characteristic parasites of pocket gophers in North America. Two species were heretofore known: *Foxella ignota* (Baker 1895) and *Foxella mexicana* I. Fox 1939. Nine subspecies of *ignota* have been described. As might be expected, because of the subterranean habits of the host, the eye is vestigial in both species. Among the material collected by the Fourth Hoogstraal Biological Expedition to Mexico is a very distinct undescribed species.

Foxella hoogstraali sp. nov. Plates 34, figs. 1–5; 35.

Near *F. mexicana* I. Fox 1939 (of which only the female is known) in that the second preantennal row of bristles consists of seven bristles, not four, and the caudal margin of the female seventh sternum is concave near the ventral margin. Distinct from paratype female of *mexicana* in that the seventh sternum bears a row of about ten long bristles preceded by seven small ones, not a row of twelve long bristles preceded by two rows of four bristles and seven small ones. The seventh sternum, though variable in shape, seems to lack the median convexity of *mexicana*. Other differences: Metepimeron in new species with about twelve bristles, not sixteen; lateral metanotal area with five or fewer bristles,

not seven; an apical bristle of metatibia extending distad of apex of first tarsal segment of metatarsus; apical bristle of first metatarsal segment extending to apex of third, not merely to apex of second.

Further separated from *ignota* in that the immovable process of the male clasper is rounded apically, not conical. The male eighth sternum lacks a stout apical bristle which is longer and stouter than the others and it is not produced into a narrow process apicad of the apical bristle. The aedeagal crochets (pl. 34, fig. 5, *CR.*) are apically broadly lanceolate, not somewhat sickle-shaped (pl. 34, fig. 6, *CR.*). The armature of the sclerotized sheath of the inner tube (*A.I.T.*) is markedly sinuate, instead of merely being developed into a slight tubercle. The lateral lobes of the aedeagus (*L.L.*) are apically biconcave, not biconvex.

Male and Female: Head (pl. 34, fig. 1, male).—Fronto-clypeal margin evenly rounded; tubercle high, above level of most dorsal preantennal bristle. Preantennal region with two irregular rows of bristles; about eight bristles in first row (sometimes appearing as 7–1) and about seven in second. Eye completely vestigial. Genal process apically acuminate, with two small bristles on each side ventrad to labrum. Maxillary lobe (*MX.*) not reaching apex of second segment of five-segmented labial palpus. Prementum of labium well developed, appearing as a palpal segment. Scape of antenna with an apical fringe of about ten bristles that are slightly longer than antennal club. About ten very small bristles bordering dorsal margin of antennal groove. Postantennal region with a large ventral bristle near antennal groove and a caudo-marginal row of long bristles.

Thorax.—Pronotal comb with a total of about twenty spines, preceded by a row of about six or seven long bristles on each side, the ventralmost the longest. Mesonotum and metanotum each with two rows of bristles. Three seta-like extensions suggesting thin elongate spinelets, on each side of mesonotum. Metanotal flange with a short apical spinelet. Mesepisternum (*MPS.*) usually with five or six bristles. Mesepimeron (*MPM.*) with about eight or nine long thin bristles. Lateral metanotal area with a row of four or five bristles, sometimes with an additional smaller bristle preceding the row. Metepisternum with four long bristles near dorso-caudal angle. Metepimeron with about twelve bristles usually arranged 4–6–2 or 3–1–5–3.

Legs.—Meso- and metafemora with a longitudinal row of long lateral bristles. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	192	77	73	58	53	128
Meso-	295	138	106	80	64	128
Meta-	445	358	211	128	87	144

Hindtarsus with an apical bristle of first segment extending beyond apex of second and with an apical bristle of second extending beyond apex of fourth segment. Blade of unguis somewhat more than twice the length of recurved basal portion.

Abdomen.—First tergum with three rows of bristles, the first incomplete. Male with one apical very small tooth on each side of terga one to four; female with tergal teeth 1–1(2)–1–0(1). Second row of tergal bristles extending ventrad of spiracles; bristles very long, often extending beyond tergal margin. Female with two rows of four small bristles. Abdominal sterna two to six with a row of four or five long ventro-marginal bristles preceded by three or four small ones. Male with three antepygidial bristles (pl. 34, fig. 4, *A.B.*), but dorsal bristle extremely reduced; middle bristle somewhat longer than ventral. Female usually with three antepygidial bristles (pl. 35, fig. 3, *A.B.*), of which the dorsal is almost

half the length of the others; some with four bristles on both sides or on one side, because of an accessory subdorsal long bristle.

Modified Abdominal Segments: Male (pl. 34, fig. 4).—Eighth tergum with about thirty long lateral or marginal bristles distributed as in figure and with a patch of very small mesal subdorsal bristles. Eighth sternum (pl. 34, fig. 3) proximally broad; apical portion shaped like an isosceles triangle; a ventro-marginal row of about seven bristles, the ultimate two the longest and near apex.

Immovable process of clasper (*P.* and pl. 35, fig. 2) broad, apically rounded and with about four small thin bristles; caudal margin with a broad shallow sinus distad of the two relatively widely separated acetabular bristles. Movable finger (*F.* and pl. 35, fig. 2) long and narrow, almost four times as long as broad at maximum; distance between its apex and apex of immovable process almost equal to length of *P.;* a short apical bristle, three long marginal bristles near dorso-caudal angle and two long bristles on caudal margin distad of midpoint; apical half with margins subparallel, straight (except for rounded apex); cephalic margin convex at proximal third. Manubrium (*MB.*) with margins suggesting a 45 degree angle, but apex somewhat oblique; longer than tergal apodeme of ninth tergum, which forms dorso-proximal portion of clasper lobe.

Ninth sternum well sclerotized, with proximal arm (*P.A.9*) subequal in length to distal arm (*D.A.9*) and apically curving dorsad, then cephalad. A very well-developed spring arising from angle of proximal and distal arms. Distal arm (*D.A.9* and pl. 35, fig. 1) bilobed because of a prominent, deep, rounded sinus on caudal margin. Proximal lobe of distal arm strongly convex, though somewhat flattened, with three or four long marginal bristles, three much smaller adjacent lateral submarginal bristles and a similar small, more proximal bristle. Apical lobe of distal arm more than twice the length of the sinus and about twice as long as broad, with about sixteen thin scattered bristles as shown in figure.

Aedeagal apodeme (pl. 34, fig. 5, *AE.A.*) long and narrow and with an apical appendage (*AP.A.*). Proximal spur (*P.S.*) present. Neck region (*N.*) of aedeagus slightly broader than long (measured between rapidly flaring portions). Expanded endchambers—measured from ventral margin of lateral lobe (*L.L.*) to dorsal margin of median dorsal lobe (*M.D.L.*)—somewhat more than twice as broad as aedeagal apodeme. Lateral lobes (*L.L.*) well developed; ventral margin broadly convex and extending well ventrad of penis rods; caudal margin biconcave, with the resulting convexity well rounded. Median dorsal lobe (*M.D.L.*) simple, unflared, apex subtruncate. Crochets (*CR.*) with proximal margin biconvex; proximally well sclerotized; dorsal margin convex; ventral margin biconcave, but sinuses shallow, and the bulge situated at insertion of small barrel-shaped sclerotization; apex subacuminate; apical three-fifths shaped like an isosceles triangle. Armature of sclerotized sheath of inner tube (*A.I.T.*) developed as a strongly arched vermiform structure. Apex of sclerotic inner tube (*A.S.I.*) appearing as a recurved sclerite mesad of apex of *A.I.T.*, broadest at apical third. Inner tube proper not apparent. Apodemal strut supporting inner tube consisting of a fairly broad, apically curved dorsal lobe (*D.S.*), a fairly broad mesal lobe (*M.S.*), and a somewhat curved lateral ventral lobe (*L.S.*). The crescent sclerite (*C.S.*) arching dorsad of sclerites of apodemal strut, about five times as long as broad. Penis rods (*P.R.*) extending only slightly beyond apex of aedeagal apodeme; uncoiled. Dorsal intramural rod of endophallus (*D.I.R.*) slightly sclerotized but visible. Ventral intramural rod (*I.R.*) well developed, extending cephalad about half of length of entire aedeagus.

Tenth abdominal segment conspicuous; sensilium relatively flat; dorsal lobe of proctiger subconical, with a fringe of apical and subapical bristles; ventral lobe of proctiger similar, but with an apical tuft of bristles. Proximal ventral sclerite represented by a subtriangular dark area.

Modified Abdominal Segments: Female (pl. 35, fig. 3).—Seventh sternum (*7 S.*) slightly sinuate (pl. 35, fig. 3) or with a definite median sinus (pl. 35, fig. 4); a small shallow sinus

near ventral margin; a row of eight to ten long bristles preceded by about six or seven smaller ones. Eighth tergum (*8 T.*) with four or five bristles ventrad to sensilium, and about 30 fairly long bristles on ventral portion, often in five irregular rows, arranged as in figure. Dorsal anal lobe with several rows of small and long bristles, the longest ones marginal and apical. Anal stylet (pl. 35, fig. 5) about two and three-fourths to three and one-half times as long as broad at maximum, with two long apical bristles and one fairly long ventral bristle. Ventral anal lobe (*V.A.L.* and pl. 35, fig. 6) angulate near base, with many bristles, most of them lateral and scattered, some mesal and marginal. Spermatheca (*SP.* and pl. 35, fig. 7) with head almost as broad as long, dorsal and ventral margins strongly convex; tail about as long as head, with an apical sclerotized papilla.

Holotype.—A male from Mount Tancítaro, at 10,500 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico. Collected July 21, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Zygogeomys trichopus* Merriam, a pocket gopher.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Twenty-one males and thirteen females from the plateau (6,000 feet altitude) near the municipality of Tancítaro and from Mount Tancítaro at altitudes from 6,000 to 10,000 feet. Collected June and July, 1941, by Robert Traub, Harry Hoogstraal, and Ralph Haag. Same host as holotype. In the collections of the United States National Museum, the Rocky Mountain Laboratory (Hamilton, Montana), the San Francisco Plague Laboratory, the Dominion Entomological Laboratory (Kamloops, British Columbia), the British Museum (Natural History), and Robert Traub, E. W. Jameson, and other miscellaneous collections.

Remarks.—It is well known that although pocket gophers may be abundant in a local area, they often have a discontinuous distribution. This probably accounts for the many named forms of both host and ectoparasites. It is interesting to note that the series of *hoogstraali* shows variations that are correlated with locality. Those females collected at 6,000 feet altitude have a definite sinus on the seventh sternum (pl. 35, fig. 4); those taken on Mount Tancítaro at altitudes from 9,800 to 10,500 feet lack this sinus (pl. 35, fig. 3).

The species is named for Mr. Harry Hoogstraal, who, through his expeditions to Mexico, has done much to help us understand the ectoparasites of the mammals of this country.

Among the Siphonaptera collected by the Third Hoogstraal Biological Expedition to Mexico (1940) is this new species of *Orchopeas* from a tree-squirrel.

Orchopeas fulleri sp. nov. Plates 36, 37.

Agrees with *O. sexdentatus* (Baker 1904) in that the male possesses five spiniforms on the movable finger, but resembles *O. howardii* (Baker 1895) in that the movable finger is as broad as high and the apical lobe of the distal arm of the male ninth sternum is broader than high.

Male and Female: Head (pl. 36, fig. 1, male).—Fronto-clypeal margin evenly rounded, with frontal tubercle median and distinct, arising from a marginal sclerotization. Prean-

tennal region with six bristles: the first very small and bordering antennal groove at level of tubercle; the second somewhat larger, more median, near antennal groove; the third median, larger; the remaining three in a row ventro-cephalad of well-developed, subovate eye. Five or six tiny bristles bordering antennal groove, and one or two intercalated between setal bases.

Epipharyngeal stiletto (*EPX.*) arising between maxillary palpi; very finely micro-denticulate apically. Maxillary lobe (*MX.*) extending just distad of base of third maxillary palpal segment. Maxillary laciniae (*LAC.*) (mandibles of authors) slightly wider than epipharyngeal stiletto, one-third of diameter of labial palpus, with apical two-thirds denticulate or micro-serrate, the serrations directed ventrad. Epipharyngeal and lacinial stilettos and five-segmented labial palpi (*L.P.*) all extending slightly distad of apex of procoxae. Scape of antenna less than two-thirds of length of ellipsoidal nine-segmented clavus; five tiny bristles near insertion, two or three near dorso-caudal angle, and an apical row of very small bristles. Second segment of antenna with somewhat longer bristles; in male, bristles extending one-fourth of length of clavus, in female, about three-fourths. About fifteen very small bristles in an irregular row bordering dorsal margin of antennal groove; caudal bristles paired. Postantennal region with two small and one large median bristle, and with a marginal row of five bristles displaced onto the head flange proper, caudad of flange sulcus; bristle at ventro-caudal angle very long, reaching mesepisternum. Female with an additional bristle ventral to the ultimate very long bristle.

Thorax.—Pronotum with a row of five bristles, with intercalated fine hairs and a ctenidium with about nine spines on each side, the most ventral being very narrow. Mesonotum with fine small bristles bordering cephalic margin; two rows of five median bristles, the caudal row of larger bristles, with very fine small ones intercalated between their bases, and, on the caudal margin, three seta-like extensions, suggesting thin elongate spinelets. Mesepisternum (*MPS.*) in male with three bristles; in female with apparently two median and two submarginal (caudal) bristles. Mesepimeron (*MPM.*) of male with five bristles in a median row of three, and a submarginal row of two interrupted by the spiracle; in female apparently with only four bristles. Metanotum with two rows of bristles of about five each, those in caudal row much longer. Male with an apical spinelet on flange, female with two. Lateral metanotal area (supraepisternum of authors) subquadrate, with two bristles at caudal margin. Metepisternum with a bristle at caudal margin near dorsal third. Metepimeron in male with five bristles arranged 2–2–1; seven bristles, irregularly arranged, in female.

Legs.—Femora with one mesal bristle but no lateral ones. Most of dorso-lateral bristles of tibiae paired. A pair of unequal long bristles at latero-ventral angle of tibiae; immediately proximad a pair of very much smaller bristles. Proportionate measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	153	35	57	44	44	118
Meso-	259	102	99	70	57	118
Meta-	345	272	163	115	70	131

None of tarsal bristles reaching beyond apex of following segment, most not extending beyond three-fourths. Blade of unguis somewhat more than twice the length of the thickened recurved basal portion.

Abdomen.—Abdominal terga on each side typically with about four small bristles in cephalic row and five or six long bristles in caudal row, the most ventral bristle inserted just ventro-caudad of spiracle. First tergum of male with one apical tooth or spinelet, second and third with two teeth, and fourth with one; female with tergal teeth 1–2–1–1. Both

sexes with one bristle on basal sternum and with sterna three to six with a row of three or four bristles. Male with three antepygidial bristles (pl. 36, fig. 2, *A.B.*), but the dorsal one greatly reduced. Ventral bristle somewhat less than half of middle one. Female with middle antepygidial bristle (pl. 37, fig. 3, *A.B.*) probably approximately twice the length of the others (broken off in allotype).

Modified Abdominal Segments: Male (pl. 36, fig. 2).—Seventh sternum truncate, with three bristles. Eighth sternum (*8 S.* and pl. 37, fig. 2) reduced, narrow, truncate apically, spiculose and with delicate, marginal, frayed micro-extensions; a lateral, ciliated and frayed membranous flap extending far caudad. X-gland of Wagner (*X.G.*) conspicuous near base of eighth sternum. Eighth tergum (pl. 36, fig. 4) large, spiculose near dorso-cephalic angle, with six dorso-marginal and four dorso-median bristles, and three bristles near ventro-caudal margin. Immovable process of clasper (pl. 36, fig. 2, *P.* and pl. 37, fig. 5) broad; apically an obtuse cone with three small apical bristles; caudal margin running ventro-caudad in a straight line to insertion of antepygidial bristle just ventrad of midpoint, and then curving ventro-cephalad; a slight sinus ventrad of the two long acetabular bristles. A well-developed concave sclerotization on immovable process of clasper, the sinus facing caudad, the process therefore appearing narrow. Movable finger (*F.* and pl. 37, fig. 5) large, cephalo-caudad diameter (at level of second most ventral spiniform) as long as maximum height (dorso-ventral diameter); cephalic margin angulate and with two thin, small, marginal bristles; dorsal margin rounded and with three small marginal bristles; caudal margin rounded except for slight crenulations near spiniforms; ventral margin shallowly arcuate, the sinus ventrad; a long marginal mesal bristle at dorso-caudal angle; a mesal, submarginal, short, thick spiniform near base of above bristle; four similar mesal spiniforms along ventral half of caudal margin; and with three or four scattered, small, median, thin bristles. Manubrium (*MB.*) relatively short and thick, less than twice as long as wide near base, and almost as wide at base as the apodeme of ninth tergum, which forms apparent dorso-proximal portion of clasper lobe; with an apical thumb-like projection. Ninth tergum apparently reduced to a very narrow area between its apodeme (*T.AP.9*) and clasper lobe. Subpygidial sclerite of Wagner conspicuous, median, shaped like a flattened discoid seen on end, lying at 45 degree angle with the longitudinal axis of the body.

Ninth sternum large, U-shaped, its proximal arm (*P.A. 9*) well sclerotized, of same width throughout, apically rounded. Trough slightly wider than proximal arm and bearing a long apodemal rod (*AP.R.*). Distal arm (*D.A. 9* and pl. 36, fig. 3) very wide, about four times as wide as proximal arm; apically bilobed, each lobe conspicuous. Apical lobe of distal arm wide, dorso-ventral dimension about three-quarters of cephalo-caudal dimension; dorsal margin shallowly sinuate; caudal margin rounded; marginal bristles at cephalo-dorsal angle, dorso-caudal portion, and ventral margin, and more than twenty scattered median bristles. Proximal lobe of distal arm with length and height in above ratio; a conspicuous marginal subapical spiniform, a more cephalic bristle and another more ventral bristle; a slight sinus at ventro-caudal angle; a bristle on ventral margin.

Aedeagal apodeme (pl. 37, fig. 4, *AE.A.*) elongate, portion cephalad of apodemal strut about seven times as long as apodeme is broad at maximum; sides subparallel and produced into a short, thumb-like process; middle plate of apodeme deeply concave near apodemal strut. Lateral apodemal plates produced into dorsal spurs and extending ventrad and distad of spur to near apex of median dorsal lobe. True accessory lateral lobes absent. Wall of aedeagal pouch (*P.W.*) arising at level of proximal spur (*P.S.*); well sclerotized, simulating the lateral lobes, strongly convex and extending to apodemal strut. Median dorsal lobe (*M.D.L.*) with dorsal margin shallowly convex, apically angled and acuminate. True lateral lobes undeveloped; apparently restricted to a semimembranous area near base of crochets. Crochets (*CR.*) beak-shaped, base not visible in cleared specimens. Sclerotized inner tube vertical, apically expanded and concave, its armature (*A.I.T.*) represented only

by lateral thickenings. A narrow sclerotized band of the inner tube (*B.I.T.*) extending distad of concave apex; easily confused with vermiform sclerotization of distal arm of ninth sternum (*D.A.9*). Apodemal strut (*AP.S.*) consisting of paired, curved, latero-ventral sclerites and acuminate mesal and dorsal sclerites. Penis rods (*P.R.*) long but not coiled. Ventral intramural rod well developed.

Tenth abdominal segment conspicuous; sensilium relatively flat; dorsal lobe of proctiger with small bristles on dorsal margin and a longer one at apex, spiculose, with a small delicate filamentous tufted process at dorso-caudal angle, near sensilium; ventral lobe of proctiger with an apical crown of longish thin bristles. Proximal ventral sclerite of tenth segment (sub-anal sclerite of Wagner) indistinct, oblong, long.

Modified Abdominal Segments: Female (pl. 37, fig. 3).—Seventh sternum (*7 S.*) with dorso-caudal margin slightly sinuate and with a narrow caudal sinus; with a row of five large bristles preceded by two very small ones. Eighth tergum (*8 T.*) with about seven small bristles cephalad to spiracle, two long bristles ventrad to sensilium, three ventro-cephalad of ventral anal lobe, and seven marginal bristles, as shown in figure; in addition, two mesal, stouter, shorter bristles near ventro-caudal margin. Eighth sternum narrow, without bristles. Dorsal anal lobe (tenth tergum of authors) with about 12 small scattered bristles, some marginal, and a group of five bristles near insertion of anal stylet. Anal stylet (pl. 37, fig. 1) about three times as long as wide at maximum, with a very short dorsal subapical bristle; middle bristle about the length of ventral one. Ventral anal lobe (*V.A.L.*) marginally strongly sclerotized, angulate, with four short stout marginal bristles, two long subapical ones and about four very small submarginal bristles. Spermatheca (*SP.* and pl. 37, fig. 6) with head subovate; dorsal and ventral margins slightly convex; tail angled, almost as long as head, and with an accessory sclerotized cap.

Holotype.—A male from the State of Nuevo Leon, near the municipality of Villa Santiago, Mexico. Collected June, 1940, by Harry Hoogstraal and Kenneth L. Knight. In the collection of Chicago Natural History Museum. Host: "tree squirrel."

Allotype.—A female, same data and depository as the holotype.

Paratype.—A male, same data as the holotype. In the collection of Robert Traub.

Remarks.—The species is named for my good friend Dr. H. S. Fuller, a leading student of ectoparasites.

Polygenis adocetus sp. nov. Plates 38, figs. 1–5; 39, figs. 1, 3–6.

Near *P. gwyni* (C. Fox 1914) (=*sigmodoni* Stewart 1930; synonymy confirmed by Dr. K. Jordan, in litt.), but separated as follows: Labial palpi reaching beyond apex of procoxae. Immovable process of clasper with more distal acetabular bristle definitely longer than movable finger, instead of subequal. Movable finger broader, about five and one-half, not six times as long as broad at maximum; with some caudo-marginal bristles longer than finger is broad, not with these bristles shorter than finger is broad. Male ninth sternum with heel more produced, extending as a short acuminate projection; bristles of distal arm extending well proximad of midpoint, not merely to it, and bristles longer than in *gwyni*. Male eighth sternum ventrally divided proximad nearly half way to bristles, much more deeply than in *gwyni*. Crochets with sclerotized portion proximally broader and shorter (cf. pl. 39, figs. 1 and 2, *CR.*). Female basal abdominal sternum with more than 22 lateral bristles on each side, instead

of fewer than 20. Female eighth tergum with long bristles in a vertical row that is interrupted dorsad of ventral margin, not continuous.

Separated from *P. rimatus* Jordan 1932 by the aedeagal structure and details of genitalia, and, in addition, the following: upper acetabular bristle much longer; apical arm of male ninth sternum much narrower; division of male eighth sternum extending more proximad; female basal abdominal sternum with more than 23 lateral bristles, not fewer than 20; hind tibia with a lateral naked space between subdorsal and subventral bristles from base to apex, this space absent in *rimatus;* fewer bristles on female eighth sternum from spiracle ventrad.

Male and Female: Head (pl. 38, fig. 1, male).—Fronto-clypeal margin rounded except for prominent acuminate dorsad-directed tubercle inserted slightly above level of eye and arising from a large subovate sclerotized area. Preantennal region with three rows of bristles arranged 4(uppermost longest)–3(very long)–2(uppermost inserted caudad of eye). Eye conspicuous, broad but subovate; genal process broad, becoming acuminate. Maxillary lobe extending to the apex of the third segment of the maxillary palpus. Maxillary laciniae narrow, less than one-fourth the diameter of the five-segmented labial palpi (*L.P.*), both structures extending to about apex of fore-trochanters. Scape of antenna twice or more length of second segment, with three rows of small hairs and additional marginal hairs. Second antennal segment with small hairs on ventral and dorsal margins, but not on caudal (apical) margin. Antennal club asymmetrical, with proximal segment dorsally expanded, others broader ventrally. A row of short though fairly broad bristles dorsad of antennal groove; bristle bases contiguous. Postantennal region with three rows of bristles arranged 4–4(5)–5(6); small hairs interpolated between bases of those of last row.

Thorax.—Pro- and mesonotum with two rows of bristles, metanotum with three, but first row incomplete, with small hairs interpolated between the bases of the caudal rows. Metanotal flange with five or six apical small teeth, suggesting spinelets, on each side. Mesepisternum (*MPS.*) typically with two subcaudal bristles near midpoint; sometimes with an additional subventral small bristle. Mesepimeron (*MPM.*) with three bristles, two submedian and one at ventro-caudal angle. Lateral metanotal area well developed, with two to five small subventral bristles; a long bristle at dorso-caudal angle, another (sometimes two) at ventro-caudal angle. Metepisternum with a bristle at dorso-caudal angle; divided into two by a diagonal sclerotization extending from cephalo-ventral angle to dorso-caudal angle. Metepimeron with two rows of bristles arranged 6–5.

Legs.—Profemora with about thirteen small scattered nonmarginal lateral bristles and one mesal bristle. Meso- and metafemora with a lateral row of about eight small thin bristles and two mesal rows of five and six bristles. Metatibiae with a lateral naked space between subdorsal and subventral bristle extending from base to apex. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	172	53	55	48	38	118
Meso-	259	64	102	65	37	122
Meta-	368	211	147	99	48	135

Metatarsal segments two and three with an apical bristle extending distad of following segment. Other tarsal segments with shorter apical bristles. Distal tarsal segments with three pairs of long lateral plantar bristles, a fourth pair of shorter lateral plantar bristles, and an apical submedian pair subequal in size. Blade of unguis long and narrow, about three times as long as recurved basal portion.

Abdomen.—First tergum with two rows of bristles. Males usually with five or six apical teeth on each side of first tergum; second, third and fourth terga with two such teeth. Female with tergal teeth usually arranged 4–2(1)–1–0. Caudal row of bristles on abdominal segments two to six much longer than preceding row and extending somewhat ventrad of spiracles. Male basal sternum with about eight small submedian bristles; sterna three to six with about six bristles on each side preceded on third sternum by two or three small ones. Female basal sternum on each side with about twenty-two or more bristles, of which about eight or ten are longer, more caudal, and often in a vertical row; sternum three usually with three to five small bristles preceding a row of about sixteen longer ones; sterna four to six with about six to nine bristles on each side. Only one antepygidial bristle developed in each sex, others at most vestigial.

Modified Abdominal Segments: Male (pl. 38, fig. 2).—Eighth tergum extremely reduced, represented only as a narrow short sclerite supporting its spiracle and bordering the sensilium; its margins inapparent. Eighth sternum (*8 S.*) very large, covering much of the genitalia, and extending from spiracle of eighth segment to ventral margin and apicad of insertion of movable finger; about four subventral lateral bristles.

Immovable process of clasper (*P.* and pl. 38, fig. 3) very large, dorsal margin about as long as movable finger, extending slightly distad of movable finger; dorsal margin slightly concave, caudal margin fairly straight; about twenty dorsal or dorsal marginal or submarginal bristles, two or three of these as long as the apical bristle; two long subdorsal bristles; a very long acetabular bristle, much longer than movable finger, inserted at ventral fourth; at times an accessory, much shorter and thinner, acetabular bristle inserted slightly dorsad of the long one; true second acetabular bristle inserted well ventrad, slightly longer than movable finger is broad; a sinus on ventral margin; about eight or nine short thin subventral and ventro-marginal mesal bristles. Movable finger (*F.* and pl. 38, fig. 3) about five times as long as broad at level of acetabular bristle; cephalic margin with apical three-fourths shallowly concave, with two or three short thin marginal bristles on apical half; caudal margin slightly convex and with thin marginal and apical bristles, the longest bristles distad of midpoint and only slightly longer than finger is broad. Manubrium (*MB.*) long and narrow, much longer than margin of tergal apodeme of ninth segment (*T.AP.9*), which forms dorso-proximal portion of clasper lobe and which is markedly convex subdorsally; slightly expanded apically. Ninth tergum apparently greatly reduced to a narrow indefinite area between its apodeme and clasper lobe.

Ninth sternum very well sclerotized, boomerang-shaped. Proximal arm (*P.A. 9*) about as long as distal arm; sclerotized portion ventrally concave, distally broad and bluntly rounded. Distal arm (*D.A.9* and pl. 38, fig. 4) produced slightly at heel, narrowed proximad of midpoint; morphologically dorsal (apparently cephalic) margin almost straight; apex somewhat rounded and with two short bristles; ventral margin slightly convex and bearing about fifteen long bristles, some mesal, the most proximal inserted at proximal fifth; three or four submedian mesal long bristles near apical fourth.

Aedeagal apodeme slightly longer than aedeagus proper, consisting of two apically rounded lateral plates (pl. 38, fig. 5, *L.PT.*) forming the mantle of Jordan (1939), and a middle plate (*MI.P.*) (the lamina of Jordan). Lateral plates free ventrally for most of their lengths, but more strongly sclerotized proximo-ventrad and then curving ventrad, joining, and producing a cephalad-directed extension, the heel of Jordan (*HL.*), from which arises a long narrow rod, probably a homologue of the aedeagal apodemal rod. Aedeagus with two dorso-apical flaps, resembling a cleft hood, here designated the hood flaps (pl. 38, fig. 5, and pl. 39, fig. 1, *H.F.*) (hood of Jordan), which partially enclose and extend apicad of the rounded convex median dorsal lobe (*M.D.L.*); apically rounded, proximally curved, acuminate. Lateral lobes (*L.L.*) very long, apparently arising from the heel and extending apicad to the level of the apex of the median dorsal lobe. Crochets (*CR.*) reduced much less than

half of diameter of aedeagus, the sclerotized portion subcordate in lateral aspect. Associated with crochets are a pair of prominent curved processes bearing minute spicules, here designated the crochet processes (*CR.P.*). The sclerotic inner tube elongate, consisting of two distinct sclerites: a strongly sclerotized basal portion (*I.T.-B.*) (basal segment of penis tube of Jordan) and a narrow apical portion (*I.T.-A.*) (apical portion of penis tube of Jordan); in lateral aspect the basal portion bears a ventral sinus and two rounded ventro-apical thickenings. Armature of inner tube not developed. The remarkable penis rods enter the aedeagus through a dilated structure called by Jordan the vesicle (*V.*), then extend through the inner tube and are apically prominently looped under the hood folds. Only one penis rod (*P.R.*) extending cephalad of apex of aedeagal apodeme, and that slightly, second rod much shorter; at times one of the intramural rods can be seen as a very short rod extending from near vesicle. Endchamber with a conspicuous sclerotized tube here designated the pseudotube (*PS.T.*) because of possible confusion with inner tube; pseudotube at times extending distad of the apex, with dorsal margin short, not extending beyond hood flaps, and with ventral margin extending proximad to below vesicle. Apodemal strut supporting inner tube consisting of a broad lobe (*L.S.*) arising from middle plate, curving ventrad, then caudad. This is believed to be the latero-ventral sclerite of other families of fleas. Similarly, the narrow sclerite (*C.S.*), roofing what Jordan terms the cavity (and which I believe is homologous with what Sharif [1946] considers to be a sperm-pumping organ in *Ctenocephalides*), is considered the crescent sclerite. The mesal lobe of the apodemal strut of many non-Rhopalopsylline fleas is apparently represented by a dark mass dorsad of the latero-ventral sclerite. A lateral spindle-shaped sclerite, here designated the side-piece, arises on each side from near vesicle. The resemblance of the aedeagus to that of *P. gwyni* (pl. 38, fig. 6, and pl. 39, fig. 2) is interesting.

Tenth abdominal segment conspicuous, with sensilium somewhat convex. Dorsal lobe of proctiger well sclerotized, caudad of sensilium and extending as far dorsad; subconical, with about six thin apical bristles. Ventral lobe of proctiger similar to dorsal, but more conical, slightly more ventral.

Modified Abdominal Segments: Female (pl. 39, fig. 3).—Seventh sternum (*7 S.*) dorso-caudally concave and caudally convex, with a curved row of about seven or eight bristles. Eighth tergum (*8 T.*) with a row of bristles extending from dorsum to near ventral border but interrupted subventrally, with many marginal and submarginal bristles, some mesal, arranged as in figure. Dorsal anal lobe (*D.A.L.*) with a few scattered short thin bristles and a marginal row of five or six. Anal stylet (*A.S.* and pl. 39, fig. 6) about two and a half times as long as broad base, with a long apical bristle and one or two tiny ventral and/or subapical bristles. Ventral anal lobe (*V.A.L.* and pl. 39, fig. 5) angulate, broad, about three-fourths as broad as long, with about four long caudo-marginal bristles and two adjacent submarginal bristles, one of which is short, the other long; four bristles near apex of dorsal margin. Spermatheca (*SP.* and pl. 39, fig. 4) with dorsal margin strongly arched or humped, extending almost as far dorsad as apex of tail; more than three-fourths as broad as long; tail broad, more than a third as broad as long, somewhat shorter than head.

Holotype.—A male from Acahuato, at 1,000 feet altitude (near Apátzingan), State of Michoacán, Mexico; collected July 21, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Citellus adocetus* Merriam.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Four males and eight females, same data as the holotype; six males and seven females, same host and locality as the holotype, collected July 30, 1941, by Ralph Haag and Frank Wonder; three females, same locality and host as the holotype, collected August, 1940, by Harry Hoogstraal. In the collections of the United States National Museum, the Rocky Mountain Labora-

tory (Hamilton, Montana), the Dominion Entomological Laboratory (Kamloops, British Columbia), the Museum of Comparative Zoology at Harvard College, Cornell University, the British Museum (Natural History), the Caucasus Parasitological Laboratory at Stavropol, U.S.S.R., and Robert Traub and others.

Remarks.—I am much indebted to Dr. Karl Jordan for aiding in the diagnosis of this species. The specific name is suggestive of *Citellus adocetus*, the only known host.

Family HYSTRICHOPSYLLIDAE

NOTES ON THE GENUS *CTENOPHTHALMUS* IN NORTH AMERICA, WITH DESCRIPTIONS OF NEW SPECIES

Although the genus *Ctenophthalmus* Kolenati (sens. lat.) is represented in the Old World by more than seventy species, to date only one species—*C. pseudagyrtes* Baker 1904—has been described from the New World. A very wide range has been reported for this species; it is found from the Atlantic to the Rocky Mountains in the United States and Canada. Three new species from Mexico and Central America and a new subspecies of *C. pseudagyrtes* from Mexico are described below. A redefinition of the genus is considered pertinent and is presented first.

Genus **CTENOPHTHALMUS** Kolenati

Genotype: *Ctenophthalmus bisoctodentatus* Kolenati 1863.

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Ctenophthalmus, I. Fox, Fleas of Eastern U. S., p. 34, 1940.
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Ctenophthalmus, Ewing and Fox, Misc. Publ. U. S. Dept. Agric., **500**, p. 82, 1943.
Ctenophthalmus, Hubbard, Fleas W. N. Amer., p. 343, 1947.

Fronto-clypeal tubercle prominent. Preantennal region with two rows of bristles. Interantennal groove not fully separating pre- and postantennal regions, but thickened. Eye reduced. Genal ctenidium horizontal, of three spines. Trabecula centralis absent. Antennal bristles much shorter than club. Labial palpi not extending distad of procoxae; apical segment with a relatively curved distal bristle. Pronotal ctenidium with a total of about fourteen or sixteen spines. Profemora lacking small submedian lateral bristles but with one such mesal bristle. Meso- and metafemora lacking small mesal bristles. Distal segment of foretarsi and midtarsi with four pairs of lateral plantar bristles and a proximal and a distal submedian pair. Distal segment of hindtarsi usually with but three pairs of lateral plantar bristles and similar proximal and distal submedian pairs, but at times with four lateral pairs. With three antepygidial bristles on each side. Male eighth tergum relatively reduced, not extending caudad of claspers. Male eighth sternum very well developed, extending caudad of apex of ninth sternum, and well dorsad of base of movable finger. Only one or no acetabular bristle present, inserted distad of base of movable finger. Movable finger without spiniforms. Angle of male ninth sternum lacking an apodemal rod; distal arm simple, unlobed, without spiniforms.

Aedeagal apodeme long and narrow; lateral plates longer than middle, each bent and arched dorsad into a sail (pl. 40, fig. 3, *S.*), the sails almost contiguous, not extending distad.

Apical appendage and proximal spur absent. Base of aedeagal pouch encircling aedeagal apodeme at level of middle of sail as a somewhat sclerotized girdle (*G.*), extending caudad as a keel (*K.*). Lateral lobes (*L.L.*) proximally narrow, not covering penis rods. Median dorsal lobe arched, apically paired and with distinct apical sclerites. Crescent sclerite (*C.S.*) relatively long, longer than lateral ventral sclerite (*L.S.*) of apodemal strut. Apodemal strut consisting of three sclerites. Armature of sclerotized sheath of inner tube (*A.I.T.*) reduced. Sclerotization of sheath of inner tube appearing as dorsal and ventral elongate subtriangular sclerites (*D.S.I.*, *V.S.I.*). Apex of sclerotized sheath of inner tube (*A.S.I.*) open, not extending distad of lateral lobes. Apodemal rod arising among the two penis rods. Penis rods uncoiled.

Female with ventral anal lobe lacking stout short recurved bristles; usually with four long bristles. Spermatheca with head longer than broad.

Discussion.—The genus *Ctenophthalmus* has been variously placed in the Hystrichopsyllidae and in the Ceratophyllidae (Dolichopsyllidae) on morphological grounds other than the structure of the aedeagus and of the male eighth segment. In my opinion, the following are arguments against affinities with the true ceratophyllids: the proximal origin of the aedeagal pouch; the presence of the girdle and keel of the aedeagus; the short crochets; the horizontal sclerotic inner tube; the absence of an apodemal rod on the ninth sternum; the absence of the two typical acetabular bristles; the reduction of the male eighth tergum and the hyperdevelopment of the male eighth sternum; the shape and chaetotaxy of the female ventral anal lobe.

Ctenophthalmus haagi sp. nov. Plate 40.

Near *C. pseudagyrtes* Baker 1904 but separated as follows: Process *P2* of immovable clasper (pl. 40, fig. 11) narrower, definitely narrower than *P1* at level of third long marginal bristle, not subequal (pl. 43, fig. 1). Acetabular bristle inserted far proximad of *P2*, instead of near base of *P2*. Eighth sternum of male with ten or eleven bristles (pl. 40, fig. 2), not six or seven (pl. 43, fig. 2). Distal arm of ninth sternum (pl. 40, fig. 6) broader and with more subdorsal bristles (cf. pl. 43, fig. 6). Crochets (pl. 40, fig. 5, *CR.*) almost as broad as long, apically obtuse, instead of definitely longer than broad (pl. 43, fig. 5, *CR.*). Armature of sclerotized sheath of inner tube (*A.I.T.*) biconvex, not developed into a thumb-like projection (pl. 43, fig. 5, *A.I.T.*). Female seventh sternum (pl. 40, fig. 7, *7 S.*) slightly sinuate, instead of definitely biconvex, with the lobes very large (pl. 43, fig. 4).

Male and Female: Head (pl. 40, fig. 1, male).—Fronto-clypeal margin evenly rounded; tubercle median, prominent. Preantennal region with two rows of bristles, the first of five or six bristles, the second of three longer bristles. First spine of genal ctenidium more acuminate than second; second partially overlapping third at base; third spine longest and most acuminate. Genal process extending almost as far distad as ultimate spine, apically subrounded. Maxillary lobe (*MX.*) extending to middle of third segment of five-segmented labial palpi (*L.P.*), which in turn almost reach apices of procoxae. Row of very small bristles dorsad of antennal club in female extending caudad of fossa; not curving ventrad in male. Postantennal region with bristles arranged 2–3–4, the ultimate row the longest.

Thorax.—Five long bristles preceding the eight ctenidial spines on each side. Mesonotum with four rows of bristles, those of the first two very short and thin, those of the

ultimate row the longest. Metanotum with two rows of bristles, those of the ultimate row the longest. Mesepisternum (*MPS.*) with two bristles near ventro-caudal angle. Mesepimeron (*MPM.*) with five bristles arranged 3–2. Lateral metanotal area well developed, subquadrate, with two (or three) bristles near dorso-caudal angle. Metepisternum with a caudo-marginal bristle. Metepimeron with five bristles arranged 2–3.

Legs.—All femora lacking small thin lateral submedian bristle. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	115	45	45	40	32	67
Meso-	180	69	45	48	35	72
Meta-	237	186	128	85	50	82

Second segment of metatarsus often with apical bristle reaching slightly distad of apex of following segment. All other tarsal segments with apical bristles not reaching apex of following segment. Hindtarsi with three pairs of lateral plantar bristles and a proximal and a distal submedian pair. Blade of unguis about twice the length of thickened recurved basal portion.

Abdomen.—First tergum with three rows of bristles, the first row very incomplete. Male with an apical very small tooth on each of first four terga; female with apical teeth arranged 1–1–1–0. Second row of bristles extending slightly ventrad of the lanceolate spiracles. An incomplete accessory row of small bristles on some terga. Male sterna three to six with three subventral bristles, preceded by one smaller one; female with bristles arranged 2–4. Male with middle antepygidial bristle (pl. 40, fig. 4, *A.B.*) more than twice the length of dorsal and ventral ones. Female (pl. 40, fig. 7, *A.B.*) with middle bristle twice the length of dorsal bristle, ventral bristle somewhat longer than dorsal.

Modified Abdominal Segments: Male (pl. 40, fig. 4).—Eighth sternum with about eleven bristles arranged as in pl. 40, fig. 2. Immovable process of clasper divided by a prominent sinus into two lobes (*P1* and *P2* and pl. 40, fig. 11). *P1* and *P2* subequal in length; *P2* slightly narrower. Immovable process with a subdorsal bristle, two subapical fairly long bristles and two caudo-marginal very long bristles on *P1;* another very long marginal bristle at the depth of the sinus. Acetabular bristle inserted at the midpoint of the caudal margin of the immovable process. Movable finger (pl. 40, figs. 4 and 11, *F.*) for most of its length narrower than the immovable process and extending distad twice as far; margins subparallel except for even curve at cephalo-apical angle and at proximo-caudal angle; a row of about eight short bristles bordering cephalo-apical margin and three longer caudo-apical marginal bristles; four longer bristles slightly apicad of midpoint of caudal margin. Manubrium (*MB.*) broad, curved, short, about equal in length to distance from base of *F.* to cephalic margin of tergal apodeme of ninth tergum, which forms the dorso-proximal portion of clasper lobe. Proximal arm of ninth sternum (*P.A.9*) about equal in length to distal arm (*D.A.9*) and with apical portion expanded; biconcave ventrally and apically slightly acuminate. Distal arm (pl. 40, fig. 6) proximally slightly more narrowed than apically, with an apico-ventral fringe of about seven long bristles, and with about twelve small thin scattered lateral bristles, two more marginal and subapical.

Aedeagal apodeme (*AE.A.*, pl. 40, fig. 3) with lateral plates bent and arched dorsad slightly proximad of midpoint of apodeme, the resulting sail (*S.*) sclerotized and sinuate, almost contiguous. Base of aedeagal pouch sclerotized as a girdle (*G.*) and encircling aedeagal apodeme at about level of sail. Lateral lobes (*L.L.*) arising as a sclerotized line, more feeble apically and curving dorsad at level of caudal margin of crochets. Median dorsal lobe (*M.D.L.*) convex, apically sclerotized and with a recurved apical sclerite (*A.M.S.*) on each side. Crochets (*CR.*) very broad, almost as broad as long; base narrowed and well sclerotized;

cephalic margin angled, straight proximad of angle, concave apicad; caudal margin strongly convex; apex a blunt lobe. Ventral sclerotization of sheath of inner tube (*V.S.I.*, pl. 40, fig. 5) not extending as far distad as dorsal sclerotization (*D.S.I.*), both acuminate apically. Armature of sclerotized sheath of inner tube (*A.I.T.*) biconvex, the apical extension somewhat pointed. Apodemal strut supporting inner tube consisting of a dorsal, convex, apically truncate lobe (*D.S.*), a lateral ventral curved lobe (*L.S.*) and a mesal narrow lobe (*M.S.*), which is partially covered by the lateral ventral lobe. The elongate crescent sclerite (*C.S.*) extending from base of dorsal lobe of apodemal strut to base of dorsal sclerotization of inner tube. Ventral intramural rod of endophallus (*I.R.*) sclerotized, extending cephalad almost as far as does the apodemal rod, which in turn arises among the penis rods and extends cephalad of apex of aedeagal apodeme.

Sensilium relatively flat. Dorsal lobe of proctiger long and narrow, with rows of thin small bristles and a long subapical one. Ventral lobe of proctiger broader than dorsal lobe, with two long apical bristles.

Modified Abdominal Segments: Female (pl. 40, fig. 7).—Caudal margin of seventh sternum (*7 S.*) with a broad shallow sinus on dorsal part; curving ventro-cephalad at ventral fifth. Seventh sternum with a row of six or seven long bristles, preceded by four or five much smaller ones. Eighth tergum (*8 T.*) without any long bristles ventrad of sensilium and without true caudo-marginal bristles; six long ventral submarginal lateral bristles, a similar bristle more dorsal, and two or three small thin ventro-median bristles; four or five very short thin mesal bristles ventrad to ventral anal lobe. Eighth sternum (*8 S.*) rectangular, feebly sclerotized, with an apical tuft of five or six tiny bristles. Dorsal anal lobe (*D.A.L.*) with small dorso-marginal bristles and a longer ventral subapical bristle. Anal stylet (pl. 40, fig. 9) about three times as long as broad at base, with a long apical bristle and very much shorter subapical dorsal and ventral bristles. Ventral anal lobe (*V.A.L.* and pl. 40, fig. 10) with ventral margin convex; two marginal straight bristles near height of convexity and two much longer subapical ones; apex extended as an acuminate projection. Spermatheca (*SP.* and pl. 40, fig. 8) with head subovate, almost twice as long as broad at maximum, and with dorsal and ventral margins subparallel; tail about half as broad as head and more than half as long. Bursa copulatrix (*B.C.*) with apex subglobose.

Holotype.—A male from Mount Tancítaro, at 7,800 to 10,500 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico. Collected July, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Microtus mexicanus phaeus* Merriam.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Four males and seven females, same data as the holotype; one male, same collector and locality as the holotype, collected at 11,000 feet altitude from *Peromyscus melanotis* Allen and Chapman. In the collections of the United States National Museum, the Rocky Mountain Laboratory (Hamilton, Montana), the San Francisco Plague Laboratory, the British Museum (Natural History), and Robert Traub.

Remarks.—I take great pleasure in naming this species for Ralph Haag, entomologist with the Fourth Hoogstraal Biological Expedition to Mexico, who generously co-operated in the collection of host mammals.

Ctenophthalmus expansus sp. nov. Plate 41.

Near *C. haagi* sp. nov. and *C. pseudagyrtes* Baker 1904 but very distinct in that the distal segment of the hindtarsus has four pairs of lateral plantar bristles,

not three, and also distinct in the shape of the movable finger, details of immovable process and of the aedeagus. Movable finger (*F.*, pl. 41, fig. 2) greatly expanded; cephalic margin biconvex, and middle of caudal margin strongly convex, instead of having cephalic margin fairly straight and proximally broad (pl. 40, fig. 11 and pl. 43, fig. 1). Process *P2* of immovable clasper lacking acetabular bristle, subtruncate and much broader than *P1*, instead of *P2* and *P1* being at most subequal and possessing an acetabular bristle. Armature of inner tube (pl. 41, fig. 5, *A.I.T.*) and base of crochet (*CR.*) extending dorsad of crescent sclerite (*C.S.*), not merely to half its height (pl. 40, fig. 5). Crochet very feebly sclerotized except at base, unlike the other species. Only the male of this interesting species is known. The following description stresses differences between *haagi* and *expansus*.

Labial palpi slightly less than three-fourths of length of procoxae. Pronotal ctenidium with a total of fourteen spines. Metepimeron with six bristles. Measurements of tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	144	45	48	43	35	75
Meso-	214	72	67	53	42	83
Meta-	300	220	141	83	58	87

Distal segment of hindtarsus (like those of other legs) with four lateral plantar bristles in addition to a submedian proximal and a submedian distal pair. Antepygidial bristles broken in unique specimen.

Eighth sternum (pl. 41, fig. 1) with nine bristles arranged 2–4–3. Immovable process of clasper divided by a sinus into two lobes, *P1* and *P2* (pl. 41, fig. 2). Process *P1* rounded, with a proximal sclerotization near cephalic margin, and with apparently three very long latero-median bristles (one missing in unique specimen) and four much smaller apical or subapical bristles. The sinus between *P1* and *P2* as broad as *P1*. Process *P2* truncate, with lateral margins straight, more than one and one-half times as broad as *P1* measured at level of second very long bristle; a very small bristle at cephalo-apical angle. Immovable process lacking an acetabular bristle; caudal margin straight to base of movable finger, then angled ventro-caudad. Movable finger (*F.*) somewhat gourd-shaped; base narrowed with margins curved and parallel; flaring below level of apex of *P2* and becoming greatly expanded to almost twice the diameter of *P2*, then narrowing rapidly. Cephalic margin of movable finger thus biconvex, with nine short thin marginal bristles on apical half. Caudal margin with one submarginal and three thin marginal bristles near midpoint and three thin bristles near apex, apical two longest. A few mesal and lateral median bristles as in figure.

Distal arm of ninth sternum (pl. 41, fig. 3) very similar to that of *haagi* but with fewer bristles—an apico-ventral fringe of about five bristles, five submedian bristles and three small subapical ones.

Aedeagus (pl. 41, figs. 4 and 5) and aedeagal apodeme of much the same type as that of *haagi*, but with significant differences. Median dorsal lobe (*M.D.L.*) strongly convex dorsad of crescent sclerite. Apical medio-dorsal sclerites (*A.M.S.*) lunar and oblique. Armature of sclerotized sheath of inner tube (*A.I.T.*) developed as a conspicuous curved thumb-like projection extending dorsad to level of height of crescent sclerite (*C.S.*). Crochets (*CR.*) proximally well sclerotized but very feebly sclerotized for most of their length. Cephalic margin concave, caudal margins convex. Lateral lobes (*L.L.*) weakly sclerotized, extending disto-dorsad to base of sclerotized portion of median dorsal lobe. Sclerotized

portion of intramural rod not extending cephalad to base of keel (*K.*). Dorsal lobe of apodemal strut (*D.S.*) apically acuminate.

Holotype.—A unique male from Mount Tancítaro, at 7,800 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico. Collected July 5, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Reithrodontomys c. chrysopsis* Merriam, a harvest mouse.

Remarks.—The name is suggestive of the greatly expanded movable finger as well as of the dilated endchamber of the aedeagus.

Ctenophthalmus sanborni sp. nov. Plate 42.

Near *haagi* sp. nov. and *pseudagyrtes* Baker, but separated as follows: Labial palpi only about three-fourths of length of (not subequal to) procoxae. Movable finger (pl. 42, fig. 6) with cephalic margin apically more convex, apex more acuminate (cf. pl. 40, fig. 11, and pl. 43, fig. 1). Armature of sclerotized sheath of inner tube (pl. 42, fig. 5, *A.I.T.*) reduced, not markedly thumb-like (pl. 40, fig. 5, and pl. 43, fig. 5, *A.I.T.*). Crochets (pl. 42, fig. 5, *CR.*) about twice as long as broad, of almost uniform breadth throughout and slightly dilated at apex instead of being almost as broad as long (pl. 40, fig. 5) or apically narrowed (pl. 43, fig. 5). Ventro-caudal angle of lateral lobes of aedeagus sinuate, slightly acuminate (pl. 42, fig. 5, *L.L.*), not rounded or pointed (pl. 40, fig. 5, and pl. 43, fig. 5). Ninth sternum of male with only one or two small ventral subapical bristles, not four or five. Further separated from *haagi* in that process *P2* (pl. 42, fig. 6) of immovable clasper extends distad of *P1*, the acetabular bristle is inserted at the base of *P2* (not far proximad), and the female seventh sternum is definitely bilobed (pl. 42, fig. 9, *7 S.*). In the following description differences from *haagi* are stressed.

Pronotal ctenidium with a total of about fourteen spines. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	122	44	42	35	34	72
Meso-	189	67	61	45	37	73
Meta-	256	198	138	83	42	89

Female sterna three to six with four or five bristles preceded by two or three smaller ones.

Modified Abdominal Segments: Male (pl. 42, fig. 2).—Eighth sternum with about nine long bristles arranged as in pl. 42, fig. 3. Process *P2* extending slightly more distad than *P1* (pl. 42, fig. 6) and subequal in breadth; acetabular bristle inserted at level of base of *P2*. Movable finger (*F.*) with proximal margins subparallel; cephalic margin with a slight short convexity at level of acetabular bristle, another slight convexity at level of apex of *P2*, then a curve caudad, the curved portion with a fringe of about eight thin bristles; caudal margin fairly straight—but apical fifth slightly concave—with four bristles in two groups of two near midpoint and with an apical and two subapical bristles. Distal arm of ninth sternum (*D.A.9* and pl. 42, fig. 7) as broad proximally as apically; three fairly long bristles on ventral half of apical margin, one or two smaller ventral subapical bristles, about five median ones, and three or four small bristles at apico-dorsal angle.

Aedeagus (pl. 42, figs. 4 and 5) of same general type as that of *haagi* but with important differences. Girdle (*G.*) only weakly sclerotized. Lateral lobes (*L.L.*) proximally sclerotized, then becoming submembranous except for sinuate margin at ventro-caudal angle, here also produced into an apical tubercle. Crochets (*CR.*) well sclerotized, especially along cephalic margin, about twice as long as broad, distally somewhat broader than apically. Armature of sclerotized sheath of inner tube (*A.I.T.*) reduced, at most represented by a narrow thin sclerite.

Modified Abdominal Segments: Female (pl. 42, fig. 9).—Caudal margin of seventh sternum (*7 S.*) divided by a conspicuous sinus into two broad, subequal, rounded lobes. Seventh sternum with a row of six or seven long bristles preceded by about two or three smaller ones. Ventral anal lobe (*V.A.L.* and pl. 42, fig. 11) with distance between bases of apical bristles equal to diameter of setal pits; apex produced caudad. Anal stylet (pl. 42, fig. 10) about four times as long as broad at base.

Holotype.—A male from Santa Elena, at 10,000 feet altitude, Department of Chimaltenango, Guatemala. Collected January 26, 1934, by F. J. W. Schmidt on the Field Museum–Leon Mandel Expedition to Guatemala. In the collection of Chicago Natural History Museum. Host: *Peromyscus guatemalensis* Merriam.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Two pairs, same data as the holotype. A pair collected for the University of California in the Department of Chalatenango, El Salvador, March 24, 1942, by M. Hildebrand. In the collections of the United States National Museum and of Robert Traub. Host: *Peromyscus* sp.

Remarks.—The species is named for Colin C. Sanborn, Curator of Mammals of Chicago Natural History Museum, who has co-operated greatly in the collecting of ectoparasites.

Ctenophthalmus pseudagyrtes micropus subsp. nov. Plate 43, figs. 7–9.

A series received through the co-operation of Dr. W. L. Jellison of the Rocky Mountain Laboratory, United States Public Health Service, shows interesting modifications in the direction of *C. haagi* and *sanborni.* These specimens are described as a new subspecies.

Near *haagi* and *sanborni* but with process *P2* of clasper (pl. 43, fig. 7) narrower and extending more distad than in *C. p. pseudagyrtes* Baker 1904 (pl. 43, fig. 1). Movable finger (*F.*) longer and narrower, even at base.

Aedeagus with crochet (pl. 43, fig. 8, *CR.*) broader at apex, not definitely narrowed (pl. 43, fig. 5, *CR.*). Armature of sclerotized sheath of inner tube (*A.I.T.*) broader at base, triangular, instead of being narrowed for most of its length. Lateral lobes (*L.L.*) not apically sclerotized to produce an angulate effect (cf. pl. 43, fig. 5). Distal arm of ninth sternum narrowed proximally (pl. 43, fig. 9). Female with seven or eight small bristles preceding the six long bristles of the seventh sternum (pl. 43, fig. 4), rather than about four or five, but otherwise similar.

Holotype.—A male from Sabinas, State of Coahuila, Mexico. Collected January, 1944, by Dr. L. Mazzoti. In the collection of the Rocky Mountain Laboratory at Hamilton, Montana. Host: *Neotoma micropus* Baird.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Three males, same data as the holotype. In the collections of Chicago Natural History Museum and Robert Traub.

STREPSYLLA GEN. NOV. AND NOTES ON RELATED GENERA

The literature on Siphonaptera is confusing regarding relationships between North American fleas of the genus *Phalacropsylla* Rothschild 1915 and the genera *Neopsylla* Wagner 1903, *Catallagia* Rothschild 1915, *Meringis* Jordan 1937, *Epitedia* Jordan 1938, *Tamiophila* Jordan 1938, and *Delotelis* Jordan 1937. In the original diagnoses the authors indicated that these genera were related. Nevertheless, the genus *Catallagia* has been placed in the family Ceratophyllidae (="Dolichopsyllidae") because it lacks the genal spines present in the other genera, while the remaining genera have usually been placed in the family Hystrichopsyllidae. The hystrichopsyllid genera have usually been separated into two subfamilies or tribes on the basis of the presence or absence of the frontal tubercle.

It is my belief that the above genera are all closely related, despite the fact that some forms lack the frontal tubercle. The fundamental phylogenetic significance of the frontal tubercle is generally accepted, but in my opinion its *absence* does not necessarily indicate lack of relationship with fleas in which it is present. There is, in my collection, a series of *Sternopsylla texana* (C. Fox 1914) in which some specimens possess and others lack the tubercle. Jordan (1945) showed that a deciduous frontal tubercle is characteristic of seven genera of fleas in widely separated families. In *Epitedia neotomae* Jameson 1946, the frontal tubercle is very reduced, hardly extending beyond the margin of the head. In all other respects, this species is a typical *Epitedia*.

The concept that these genera are all closely related is based upon a fundamental similarity in morphology, especially in the structure of the head and in the pattern of the male genitalia, particularly in the structure of the aedeagus and the shape and armature of the male ninth sternum. Thus, in these genera, the wall of the aedeagal pouch arises far cephalad of the apodemal strut and is very broad, while the ventral margin is well sclerotized. The third apodemal rod arises from the aedeagal pouch, not from the angle of the ninth sternum. The crochets are relatively reduced in length and do not extend far distad of the endchamber. The sclerotized inner tube is almost horizontal and is relatively unarmed. The lateral lobes arise from the dorsal and ventral walls of the proximal portion of the endchamber. It is shown elsewhere that these are characters of the type of aedeagus found in the Hystrichopsyllidae. It is my opinion that the general pattern of the male genitalia, including the structure of the aedeagus, is a character that indicates at least generic relationship, rather than a character that is largely only of subgeneric or specific value.

I consider *Catallagia* to be merely an evolutionary development from *Epitedia* or *Neopsylla* in which the genal ctenidium has been lost. Jordan recognized the affinities of *Catallagia* when he stated (1938): "*Neopsylla–Epitedia–Catallagia* are an interesting chain of genera." It is also probable that many of the species of these genera are essentially nest-inhabiting forms and as such show reduction in the development of the eye, the number of genal spines, and the chaetotaxy.

Among the undescribed material collected by me in Mexico is a new genus that helps to clarify the relationship of *Neopsylla, Meringis, Phalacropsylla, Epitedia, Tamiophila* and *Catallagia.* This new genus not only shares cardinal characters of some of the genera discussed, but possesses some important distinctive features.

STREPSYLLA gen. nov.

Genotype: *Strepsylla mina* sp. nov.

Frontal tubercle present. Genal ctenidium consisting of two overlapping spiniforms. Labial palpi extending distad of fore-trochanters. Metacoxae with a patch of mesal spinelets. Longest apical bristle of third segment of metatarsus extending well distad of fourth. Proximal plantar bristles of fifth segment of metatarsus ventral. Cephalic abdominal terga with apical spinelets. Two (rarely three) antepygidial bristles in male, three in female. Sensilium somewhat convex caudally. Proximal ventral sclerite of tenth male abdominal segment with a filamentous tufted projection. Manubrium very narrow, curved or bent cephalad at apical fourth; finger without spiniforms. Ninth sternum of male with distal arm long and narrow, with an apical claw, and possessing a feebly sclerotized lateral expansion that bears a characteristic conspicuous spiniform curved like a twisted hook. Parameres of certain authors in reality lateral lobes of aedeagus. True crochets appearing as ventral lobes of aedeagus. Aedeagal pouch twice the breadth of aedeagal apodeme. Apical sclerites of sclerotized inner tube present. Apodemal rod arising from base of aedeagus. Anal stylet of female with a very small dorsal and a vestigial ventral bristle in addition to the long apical bristle.

Discussion.—The accompanying table (p. 76) lists salient characters of *Strepsylla* gen. nov. and compares them with those of *Neopsylla, Meringis, Phalacropsylla, Epitedia, Tamiophila, Catallagia,* and *Delotelis.* The table also serves to show the relationship of these genera, and is a ready means of diagnosis. Thus it may be significant to note that in *Meringis* the apical bristle of the third tarsal segment of the metatarsus is very long, and that the tarsal claws are unusually long and thin. Consistent characters could not be ascertained for females. However, it is pointed out that in *Meringis* the ventral bristle of the anal stylet is usually missing; in the other genera it is usually present, though at times reduced or vestigial and/or subapical. In *Phalacropsylla* the anal stylet is long and narrow, nearly five times as long as wide; in the other genera it usually is about four times as long as wide.

Dr. Karl Jordan, of the British Museum, has kindly pointed out (in litt.) additional characters that demonstrate the affinities of this genus. He states that four links (vincula) between head and base of abdomen occur only in the neopsyllids and pygiopsyllids; all the other genera are without the fourth, and a few genera lack the first. The fourth link is easily demonstrable in *Tamiophila;* the other American neopsyllids lack it. Another character, according to Dr. Jordan, is that of the first link, which in ceratophyllids is seen above the posterior end of the male antenna and which rests posteriorly in a sinus of the margin of the prosternosome. He writes: "This sinus is absent in all pygiopsyllids and all neopsyllids of the Old World known to me, and also in *Tamiophila;* indicated or quite distinct in the other American neopsyllids, inclusive of *Strepsylla.*"

COMPARATIVE TABLE: *STREPSYLLA* GEN. NOV. AND RELATED GENERA

NO.	CHARACTER	STREPSYLLA GEN. NOV.	NEOPSYLLA WAGNER	MERINGIS JORDAN	PHALACROPSYLLA ROTHSCHILO	EPITEDIA JORDAN	TAMIOPHILA JORDAN	CATALLAGIA ROTHSCHILD	DELOTELIS JORDAN
1	FRONTAL NOTCH AND TUBERCLE	+	+	0	0	+	+	+	+
2	LABIAL PALPI (LENGTH)	TROCHANTER I	< 2/3 COXA I	3/4 COXA I	BASE TROCHANTER I	VARIES	3/4 COXA I	3/4 COXA I	BASE TROCHANTER I
3	VESTIG. EYE MEDIALLY UNPIGMENTEO	+	+	0	+	+	+	+	+
4	METACOXAE WITH SPINIFORMS	+	0 OR +	+	+	+	0	+	+
5	RATIO-METATARSUS SEGMENT 2:3	1.8	1.6	1.7	2	1.8	2	1.5	1.8
6	LENGTH. BRISTLES METATARSUS 2	> 4	< APEX 3	BASE 4 TO > APEX 4	APEX 5	< 4	< APEX 3	< APEX 3	± APEX 4
7	LENGTH. BRISTLES METATARSUS 3	± > 4	± APEX 4	± APEX 5	± APEX 4	< APEX 4	± APEX 4	< APEX 4	± APEX 4
8	PROXIMAL BRISTLE METATARSUS	VENTRAL	LATERAL OR ABSENT	VENTRAL	VENTRAL	ABSENT	ABSENT	ABSENT	VENTRAL OR ABSENT
9	RATIO-TARSAL CLAW LENGTH TO BASE	2 1/4:1	2 1/4:1	3-4:1	3-3 1/2:1	2 1/4:1	2 1/4:1	2:1	2 1/4:1
10	ABOOMINAL APICAL TEETH	+	+	0	+	+	+	+	+
11	NO. ANTEPYGIOIAL BRISTLES MALE	2 (3?)	3	3 OR 2	3	3	3	3	3
12	ABDOM. II STERNUM VENTRAL BRISTLES	0	0	0	0	0	+	0	0
13	PYGIDIUM CONVEX	+	+	0 OR ±	+	+	0	+	+
14	PROX. VENT. SCLER. WITH FILAMENTS	+	0	0	0	0	0	0	0
15	PROXIMAL ARM 9 STERNUM BIFIO	0	0	0	+	0	0	0	0
16	OISTAL ARM 9 ST. PROLONGEO	+	±	+	+	0	±	0	+
17	OISTAL ARM 9 ST.+ MEMBRANOUS EXPAN.	+	0	0	0	0	0	0	+
18	IBIO. EXPANSION + TWISTEO SPINIFORM	+	0	0	0	0	0	0	+
19	STRIARIUM	+	0	0	0	+	0	+	+

+ indicates that listed character applies or is present
○ indicates that character is absent
> signifies greater than, or longer than
< signifies less than or smaller than
± means approximately or somewhat
No. 14 refers to proximal ventral sclerite of male tenth segment

Strepsylla mina sp. nov. Plates 44, 45, figs. 1–4.

Male and Female: Head (pl. 44, fig. 1, male).—Fronto-clypeal margin evenly rounded, with tubercle median, distinct, arising from a sclerotized depression. Pores of microsetae scattered anterior and dorsal to first row of bristles. Preantennal region with two rows of bristles, the most cephalic row somewhat irregular, consisting of six small bristles, the caudal row consisting of four much longer bristles. A series of tiny hairs cephalad of vestigial eye. Shorter spine of genal ctenidium most laterad, directed subventrad; more mesal spine of ctenidium acute, directed subcaudad and covering most of subantennal lobe of gena. A subspherical unpigmented area in middle of area demarking vestigial eye. Epipharyngeal stiletto (*EPX.*), arising between maxillary palpi, with about four tiny nodules. Maxillary lobe (*MX.*) an acute triangle, extending to apex of third segment of labial palpus (*L.P.*). Maxillary laciniae (*LAC.*) about one-half of diameter of labial palpus; apical two-thirds with ventrad-directed denticles. Lacinial and epipharyngeal stilettos subequal in length, slightly shorter than five-segmented labial palpus, which extends beyond fore-trochanters. Bristles on second antennal segment short in both sexes, shorter than or subequal to pedicel. A row of very small bristles bordering groove of subovate nine-segmented antennal club. Inner-antennal ridge thick. Postantennal region with one or two bristles preceding two rows of four and five large bristles respectively; most ventral bristle the longest in each case.

Thorax.—Pronotal ctenidium with a total of about twelve to fourteen spines, preceded by a row of five bristles on each side, and with fine hairs intercalated between the bristles. Notum of mesothorax with a series of small hairs, a row of small bristles and a row of large bristles, the long bristles with intercalated small hairs. Mesonotum with two bristle-like extensions near caudal margin, suggesting thin elongate spinelets. Mesepisternum (*MPS.*) usually with two small median bristles and two bristles at ventro-caudal angle, one of the latter very long. Mesepimeron (*MPM.*) usually with four bristles (two near cephalo-dorsal angle, one or two at caudal margin and one on ventral margin). Lateral metanotal area (supra-episternum of some authors) with a small hair near dorsal margin and with one large bristle and a very small hair at ventro-caudal angle. Metepisternum with four bristles at dorso-caudal angle (three very small, one well-developed large bristle). Metepimeron with eight or nine bristles arranged 4–3–1, or 4–4–1, those in the first row the smallest.

Legs.—Meso- and metacoxae with thin lateral bristles near the cephalic margin for distal two-thirds. Metacoxae with a patch or row of mesal short spiniforms at cephalic margin of distal fourth. All trochanters with a row of pores near caudal margin, some pores bearing tiny hair-like structures. Profemora with about twelve small thin lateral bristles, meso- and metafemora with one each. Dorso-lateral bristles of tibiae virtually all paired; two pair of bristles at latero-ventral angle of tibiae. Measurements of tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	56	48	40	32	96
Meso-	256	96	80	56	40	96
Meta-	320	192	128	80	56	100

Longest bristle of tarsus of foreleg is on segment one; it does not reach apex of two. Second segment of metatarsus with a bristle extending almost to apex of fourth segment. No other bristles on any tarsal segment reach apex of following segment. Distal tarsal segment of each leg with four pairs of lateral plantar bristles, and with a basal median pair.

Abdomen.—First tergum with three rows of bristles, the first row very incomplete. In male, first tergum with two apical teeth on each side, second tergum with four or five, fourth with three. In female, tergal teeth arranged 1–3–3–3. Both sexes with two rows of

bristles on abdominal segments two to six; the first row always preceded by a partial row of small bristles, the most caudal rows with the longest bristles and with one or two bristles extending ventrad of spiracles. Tiny hairs intercalated between the large bristles. Both sexes with one bristle on basal sternum and with sterna three to six with a row of three bristles, preceded by one or two small hairs.

Male with middle antepygidial bristle (pl. 44, fig. 2, *A.B.*) almost twice the length of ventral bristle; dorsal antepygidial bristle almost completely vestigial, inapparent. Female with middle antepygidial bristle (pl. 45, fig. 4, *A.B.*) twice the length of ventral bristle; dorsal bristle somewhat shorter than ventral.

Modified Abdominal Segments: Male (pl. 44, fig. 2).—Eighth sternum (*8 S.*) subtruncate, with a ventral row of five or six small bristles and a large subapical bristle. Eighth tergum reduced to small plate caudad of bases of antepygidial bristles and bearing only small bristles; somewhat produced to an acute process at dorso-caudal angle. Immovable process of clasper (pl. 44, fig. 2, *P.* and pl. 45, fig. 1) very large, bilobed dorsally, with lobes broad; sinuate caudally, arcuate ventrally, the sinus ventrad; long bristles along dorsal and dorso-caudal margins; three scattered long bristles along remainder of caudal margin, the longest bristle ventrad of insertion of movable finger, and possibly representing the acetabular bristle; typical acetabular bristles absent; a circular patch of about ten curved thin bristles on mesal surface of dorsal margin of caudal lobe; a large sclerotized area covering most of caudal portion, the dorsal margin of this area bilobed or trilobed with a bristle at the apex of each lobe, and with small bristles bordering cephalic margin of sclerotized area. Movable finger (*F.*) very large, shaped like half a broad oval; a series of bristles on apical margin, the bristles in the second and third quarters very long (as long as immovable clasper is wide) and curved or lashed; a lateral patch of about twenty small submarginal bristles between basal half and three-quarters mark; apical margin slightly serrate ventrad of row of marginal bristles. Manubrium (*MB.*) boomerang-shaped or somewhat J-shaped with cephalic margin slightly sinuate; very narrow, less than half as wide as proximal arm of ninth sternum, and less than one-fourth as wide as tergal apodeme of ninth tergum (*T.AP.9*), which forms the apparent dorso-proximal portion of the clasper lobe. Ninth tergum (*9 T.*) reduced to an indistinct triangular area between its apodeme and the clasper lobe. Ninth sternum wide, U-shaped, its proximal arm (*P.A.9*) well sclerotized, widest at truncate apex, and width of rest of arm somewhat less than one-half that of base of finger. Trough of U-shaped ninth sternum as wide as proximal arm. Distal arm (*D.A.9* and pl. 44, fig. 5) of ninth sternum apically narrowed and rounded, beak-shaped, apex subacute; caudal margin arcuate, with a subapical spiniform and a row of more proximal bristles; subapical spiniform scarcely as long as apex is wide at point of insertion; dorsal margin with three or four subapical smaller bristles. Ninth sternum with a feebly sclerotized, somewhat spiculose, truncate flap or expansion (*FL.*) bearing a median singly looped spiniform on mesal aspect, and a row of about ten tiny bristles on margin ventrad of spiniform. A sclerotized structure covering dorsal half of distal arm projecting beyond its base, apparently with a dorsal extension to aedeagus. Apodemal rod of ninth sternum absent. Aedeagal apodeme (pl. 44, fig. 3, *AE.A.*) broad, with sides subparallel, cephalic end somewhat rounded. Middle plate (*MI.P.*) somewhat shorter than lateral plates. Aedeagus proper almost as long as its apodeme; region of base with a large sinus extending somewhat beyond ventral margin, the sinus directed dorsad and its margin curving dorso-caudad to form dorsal wall of endchamber; this sinus probably in middle plate. Basal margin of wall of aedeagal pouch (*P.W.*) arising at level of this sinus, very broad; cephalo-ventral portion convex, so that base is shaped like an inverted reverse question mark; ventral margin of pouch well sclerotized, continued apical to base of crochets; a stout apodemal rod (*A.A.R.*) arising from base of pouch, and a weakly sclerotized crescent-shaped structure apical of base. Apical lobes somewhat complicated. Crochets (*CR.*) conspicuous, ventral in insertion, talon-shaped but broad at base, about as broad as long. Lateral lobes arising from dorsal and ventral margins of aedeagal pouch at level of

apodemal strut and extending apicad as narrow structures with concave margins and dilated apex (pl. 44, fig. 4). The conspicuous lateral lobes extend distad of the crochets and constitute the so-called parameres of certain authors. Dorsad of crochets is a pair of short rectangular truncate lobes, here called the disto-dorsal lobes (*D.L.*). True median dorsal lobes (*M.D.L.*) paired, subtruncate, not reaching the apex. Associated with the last are what I call subapical dorsal lobes (*S.D.L.*); these are truncate, narrow and articulated near base of dorsal margin of endchamber so that lobes can be extended dorso-cephalad. Sclerotized inner tube (*S.I.T.*) short, horizontal, of one sclerite, apically unspecialized and with armature undeveloped. A large sclerite (*A.S.T.*) apicad and dorsad of sclerotized inner tube considered homologous with apical sclerite of the tube of certain other hystrichopsyllid genera. Apodemal strut consisting of a curved latero-ventral sclerite and three subparallel mesal sclerites. Ventral intramural rod (*I.R.*) very well developed. Penis rods long but uncoiled.

Tenth abdominal segment spiculose, ventrad of convex sensilium; dorsal lobe of proctiger lightly sclerotized and with small bristles; dorsal margin of ventral lobe heavily sclerotized and bearing marginal bristles, none of these longer than those of overlapping process of clasper. A subovate sclerotized structure (perhaps the proximal ventral sclerite of Snodgrass or subanal sclerite of Wagner) immediately ventrad of base of ventral lobe of proctiger, and bearing a series of branched filamentous tufts.

Modified Abdominal Segments: Female.—Seventh sternum (pl. 45, fig. 4, *7 S.*) with dorso-caudal margin sinuate and with a slight sinus at ventro-caudal angle; three rows of bristles arranged in rows of two very small bristles, about six slightly larger ones, and five large bristles. Eighth tergum (*8 T.*) with two rows of fine small bristles, the second row extending ventrad to mid-point. Eighth tergum, ventrad of ventral anal lobe, with about nine lateral marginal, seven mesal smaller submarginal, and about six lateral bristles; two laterad-directed bristles at ventral angle of ventral anal lobe. Eighth sternum (*8 S.*) narrow, without bristles. Dorsal anal lobe with a dorsal marginal fringe of bristles, the subapical bristles somewhat longer than the others and with scattered small fine lateral bristles and a long bristle at ventro-caudal angle, ventrad of insertion of anal stylet. Anal stylet (pl. 45, fig. 3) slightly more than three times as long as wide at base, with a very short dorsal subapical bristle, a very long apical bristle, and a very short subapical lateral or ventral bristle, this sometimes not apparent. Ventral anal lobe not strongly sclerotized or angulate, and lacking strongly curved stout bristles; with about five marginal bristles, that at ventral angle stouter and longer than those in middle, the two at dorsal angle almost as long as that of anal stylet. Spermatheca (*SP.* and pl. 45, fig. 2) with head subovate, ventral margin straight, dorsal surface slightly convex; tail more than one and one-half times as long as head, and more than three-quarters as wide at maximum, with dorsal margin inserted into head for about one-third of length of head; tail feebly sclerotized, lacking the subparallel ridges of the head. Bursa copulatrix (pl. 45, fig. 4, *B.C.*) sinuate, about four times the length of head of spermatheca.

Holotype.—A male from Mount Tancítaro, at 10,500 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico. Collected July 26, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Microtus mexicanus phaeus* Merriam, a Vole mouse.

Allotype.—A female, same data and depository as the holotype, but collected July 16, 1941, from *Peromyscus melanotis* Allen and Chapman, a striped mouse.

Paratypes.—Three males and two females, same data as the holotype; one male and two females, same data as the allotype, but taken at 10,000 feet altitude, July 22 and 26; one pair, same data as the allotype, but taken at 9,500 feet

altitude, July 22; six females, same data as the allotype, but collected at 10,500–11,000 feet altitude, July 16 and 19; one pair, same locality and collector as the holotype, but taken at 10,000 feet altitude from *Neotomodon alstoni* Merriam. In the collections of the United States National Museum, the Rocky Mountain Laboratory (Hamilton, Montana), Cornell University, the Dominion Entomological Laboratory (Kamloops, British Columbia), the British Museum (Natural History), Robert Traub, and other private collections.

Strepsylla fautini sp. nov. Plates 45, fig. 5; 46.

Only the male is known, but it is readily separated from *S. mina* by the following characters:

Movable finger (pl. 46, fig. 1, *F.* and pl. 46, fig. 5) with marginal bristles much shorter, scarcely longer than those on dorsal margin of *P.*, not three or four times as long. Distal arm of ninth sternum (*D.A.9* and pl. 46, fig. 3) narrow, with sides subparallel; ventral margin straight, not markedly concave apically; two stout apical bristles instead of three subapical bristles; apical spiniform longer, longer than arm is broad at this level; dorsal margin straight, not curved apicad into a beak-shaped projection. Flap of ninth sternum with a doubly not singly twisted spiniform. Base of aedeagal pouch (pl. 46, fig. 4, *P.W.*) straight, lacking the ventral sinus of *mina*. Lateral lobes (*L.L.* and pl. 46, fig. 2) of aedeagus with dorsal margin sinuate, not expanded apically. Crochets (*CR.*) longer, narrower, not talon-shaped, but acuminate.

Other differences: Mesepisternum with a row of three bristles, the middle of which is the longest. Mesepimeron with four bristles. Measurements of tibiae and segments of tarsi with little difference, viz.:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	160	57	54	42	35	92
Meso-	240	105	89	54	42	92
Meta-	307	208	128	71	52	100

Abdominal tergal teeth arranged 3–6(5)–3–3 on each side. Eighth tergum reduced, not produced into an acute process caudad of bases of antepygidial bristles. Immovable process of clasper (pl. 46, fig. 5, and fig. 1, *P.*) with dorsal margin slightly concave; caudal margin scarcely sinuate; ventral margin subtruncate; dorsal margin of sclerotized caudal area truncate.

Holotype.—A male from Mount Tancítaro, at 7,800 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico. Collected July 5, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Peromyscus hylocetes* Merriam.

Paratype.—One male, same data as the holotype, but taken at 8,000 feet altitude, July 10, 1941. In the collection of Robert Traub.

Remarks.—Hundreds of fleas were collected from various rodents taken at 7,800 to 11,400 feet altitude on Cerro Tancítaro, but all 22 fleas described as *Strepsylla mina* sp. nov. were collected above 9,000 feet, an altitude where the cloud forest is replaced by an open area of scattered pines and patches of bunch grass and lupines. The only known *S. fautini* sp. nov. were taken in the cloud

forest at 7,000 to 8,000 feet altitude. One female *Strepsylla* was taken at 7,800 feet in a nest of *Reithrodontomys c. chrysopsis* Merriam, but its bristles were too mutilated to permit assignment as to species. The seventh sternum and spermatheca were indistinguishable from those of *mina*. Another individual female indistinguishable from *mina* was collected from *Peromyscus hylocetes* at Michoacán, Cerro San Miguel, at 6,500 feet altitude, near the municipality of Tancítaro. Further collections are necessary to determine if these are the females of *fautini*.

The species is named for Dr. Reed W. Fautin, zoologist with the Fourth Hoogstraal Expedition, to whom I am greatly indebted.

NOTES ON THE GENUS *CORRODOPSYLLA* IN NORTH AMERICA

The Siphonaptera collected on Mount Tancítaro in Michoacán by the Fourth Hoogstraal Biological Expedition to Mexico (1941) included an unusual number of undescribed species. This is to be expected in view of the fact that the area has been little studied and is somewhat isolated, consisting of a small mountain range surrounded by semi-desert. It is therefore interesting to note that the shrews in this area are parasitized by a species of flea characteristic of shrews in the United States. This Michoacán series presents conspicuous differences and is described as a new subspecies. It also is of importance in helping to establish the status of *Corrodopsylla hamiltoni* (Traub 1944) and in shedding light on the host relationships of the species. In my opinion a study of the aedeagus of this species validates the use of the generic name cited.

Corrodopsylla curvata lira subsp. nov. Plate 47, figs. 1–12.

Distinct from *C. c. curvata* (Rothschild 1915) in that the female bears only an acuminate caudal projection on the seventh sternum (pl. 47, fig. 7, *7 S.*) instead of a distinct ventro-caudal sinus (pl. 48, fig. 12). The seventh sternum lacks a strongly sclerotized ventro-caudal area and it bears three small bristles preceding a somewhat curved row of five bristles; *C. c. curvata* has a conspicuous sclerotized area and the seventh sternum usually bears a curved row of seven bristles. Separated in the male by the following: Process *P1* of the immovable clasper (pl. 47, figs. 2 and 4) separated from *P2* by a distance as great as or greater than its own breadth; in *C. c. curvata* the space between the processes is subacute (pl. 48, fig. 8). Sclerotized portion of inner tube (pl. 47, fig. 6, *S.I.T.*) longer and narrower, about six or more times as long as broad at middle, not four times (pl. 48, fig. 11, *S.I.T.*), and with micro-denticulations on caudal margin smaller.

Readily separated from *C. c. obtusata* (Wagner 1929) by the absence of the sinus on the female seventh sternum and by the wide space between *P1* and *P2*.

Male and Female: Head (pl. 47, fig. 1, male).—Anterior margin evenly rounded. Fronto-clypeal tubercle and notch absent. Preantennal region with two rows of bristles, the first consisting of six or seven bristles, the second of four longer bristles in an irregular row (two near antennal groove and two near genal ctenidium). Eye reduced but apparent as a sub-

triangular spot above last spine of genal ctenidium. Genal ctenidium of four spines, the spines broad and spatulate except the first, which is somewhat narrowed apically; the comb at an angle of about 20 degrees; first spine of ctenidium as distant from margin of head as breadth at base. Genal process narrow, acuminate. Maxillary lobe (*MX.*) extending to apex of third segment of maxillary palpi. Labial palpi (*L.P.*) with apparently four segments, but with prementum large, suggesting a segment; extending only about two-thirds of length of procoxae. Antennal bristles short. Postantennal region with three rows of bristles arranged 5-5-6.

Thorax.—With five long bristles preceding the eight pronotal ctenidial spines on each side, a small hair interpolated between the bases of these bristles. Mesonotum with similar hair along thickened cephalic margin and with three rows of bristles, the first incomplete; with one apical seta-like extension suggesting a thin elongate spinelet. Mesepisternum (*MPS.*) with three bristles near ventro-caudal margin. Seven bristles on mesepimeron (*MPM.*). Metanotum with two rows of bristles. Lateral metanotal area well developed, subquadrate, with one bristle at dorso-caudal angle. Metepisternum with two unequal bristles at dorso-caudal angle. Metepimeron with seven bristles arranged 4–3.

Legs.—Profemora with about eight or ten thin small submedian bristles. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	141	48	55	46	36	77
Meso-	208	83	80	58	45	80
Meta-	310	208	138	93	58	80

Distal margin of tarsal segments somewhat excised caudally, especially on first two legs. None of tarsal bristles reaching beyond apex of following segment. Distal tarsal segment of each leg with four pairs of lateral plantar bristles and with basal pair displaced medially. Blade of unguis about two and one-half times the length of thickened recurved basal portion.

Abdomen.—Caudal margins of abdominal segments micro-denticulate. A relatively long thin apical subdorsal tooth on first four terga. Two rows of bristles on each tergum, the second row extending ventrad of the cordate or lance-headed spiracles. Female with four or five small median bristles and one or two long ventral ones on each side of basal sternum. Male similar but with two or three small median bristles. Sterna three to six on each side with two long ventral bristles in male, three or four in female, at times preceded by one or two very small ones. Middle antepygidial bristle in male (pl. 47, fig. 2, *A.B.*) almost three times the length of dorsal and ventral ones, even longer in female. A pair of caudad-directed processes between the bases of the two groups of antepygidial bristles, those of the female more acuminate (pl. 47, figs. 10 and 11).

Modified Abdominal Segments: Male (pl. 47, fig. 2).—Eighth tergum (*8 T.*) reduced to a relatively narrow sclerite supporting the very large dorso-marginal spiracle. Eighth sternum (*8 S.*) very large, extending enough dorsad and caudad to cover much of genitalia; two ventral bristles on each side. Immovable process of clasper divided by a broad subtruncate sinus to form two lobes, *P1* and *P2* (pl. 47, fig. 4). *P1* long and narrow, apically truncate and with two long apical bristles. Margin between *P1* and *P2* with a small, pointed projection. *P2* broader, apically subtruncate, cephalic margin fairly straight; two unequal though short bristles at cephalo-dorsal angle; caudal margin concave, becoming convex at the insertion of the two very unequal acetabular bristles. Movable finger (*F.* and pl. 47, fig. 4) curved cephalad and extending slightly distad of the apex of *P2*; two fairly long thin marginal bristles and about five shorter ones as shown in figure. Manubrium (*MB.*) shaped like a broad isosceles triangle, but with apex slightly curved; base broader than tergal apodeme of ninth segment, which forms proximo-dorsal portion of clasper lobe.

Ninth sternum feebly sclerotized, not apparent except for sclerotized apex of proximal arm (which resembles a crooked finger) and most of distal arm (*D.A.9*). Distal arm with apex subovate, but caudal margin slightly angulate (pl. 47, fig. 12) and bearing four long narrow marginal bristles—one on cephalic margin, one apical and two caudal.

Aedeagal apodeme longer than aedeagus proper and consisting of two long broad lateral plates (pl. 47, fig. 3, *L.PT.*) and a narrower middle plate (*MI.P.*). Apical appendage and proximal spur absent. Expanded endchamber (pl. 47, fig. 6) broader than aedeagal apodeme. Median dorsal lobe (*M.D.L.*) very broad, dorsal margin evenly rounded, associated with a sclerite approaching cephalic margin of inner tube. Lateral lobes (*L.L.*) apparently reduced to long narrow structures terminating near apex of crochets. Crochets (*CR.*) very well developed, broad, but apparently fused mesally, at least apically; about half of diameter of endchamber; proximal portion subquadrate and apical portion somewhat sagittate; ventral margin of arrowhead recurved apicad as a narrow process, with a short thumb-like projection at midbase of arrowhead. Sclerotized portion of inner tube (*S.I.T.*) prominent as a slightly curved, narrow, open structure near dorsal margin of median dorsal lobe; a row of micro-denticulations on caudal margin. Base of inner tube extending into a large sclerite which is ventrally angulate and dorsally rounded, here considered as the armature of the inner tube (*A.I.T.*).

Apodemal strut supporting inner tube consisting on each side of a narrow submedian apically expanded mesal lobe (*M.S.*) and a curved ventral lateral lobe (*L.S.*). The crescent sclerite (*C.S.*) relatively feebly sclerotized and broad. Penis rods (*P.R.*) uncoiled, extending cephalad only slightly beyond apex of aedeagal apodeme. Ventral intramural rod of endophallus (*I.R.*) well developed. Wall of aedeagal pouch difficult to see in cleared specimens, but arising far cephalad of aedeagal strut. Aedeagal apodemal rod scarcely sclerotized, not apparent.

Tenth abdominal segment conspicuous, sensilium almost flat; dorsal and ventral lobes of proctiger triangular, with tufts of apical bristles.

Modified Abdominal Segments: Female (pl. 47, fig. 7).—Seventh sternum (*7 S.*) dorsocaudally convex, caudally shallowly concave, ventro-caudally produced into an acuminate lobe, with an irregular row of five long bristles preceded by three short ones. Eighth tergum (*8 T.*) with about six submarginal ventro-caudal bristles, three short marginal ones below ventral anal lobe, three adjacent small mesal ones, and one or two median ones. Dorsal anal lobe (*D.A.L.*) with scattered bristles, the longest marginal. Anal stylet (*A.S.* and pl. 47, fig. 9) less than three times as long as broad near base, with a long apical bristle. Ventral anal lobe (*V.A.L.* and pl. 47, fig. 8) angulate; caudal margin slightly concave and longer than ventral margin, with about seven long thin marginal bristles and about five shorter submarginal bristles as in figure. Spermatheca (*SP.* and pl. 47, fig. 5) ovate, with head less than twice as long as broad; dorsal and ventral margin slightly convex; head not clearly delimited from tail; tail upcurved, broadly rounded and much shorter than head.

Holotype.—A male from Mount Tancítaro, at 7,800 feet altitude, near the municipality of Tancítaro, State of Michoacán, Mexico. Collected July 6, 1941, by Robert Traub. In the collection of Chicago Natural History Museum. Host: *Sorex saussurei* Merriam, a short-tailed shrew.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—Two males and three females, same data as the holotype. In the collections of the United States National Museum and of Robert Traub.

Remarks.—Except for differences stated in diagnosis, this subspecies is remarkably like *C. c. curvata* from Montana and British Columbia. It is profit-

able to compare this species with another that is found in the eastern United States—*C. hamiltoni* Traub.

Corrodopsylla hamiltoni (Traub). Plate 48, figs. 1–6, 10.

Doratopsylla (*Corrodopsylla*) *hamiltoni* Traub, Field Mus. Nat. Hist., Zool. Ser., **29**, p. 218, 1944.

Separated from *C. curvata* (Rothschild) as follows:

Female seventh sternum (pl. 48, fig. 6) lacking the sinus of *C. c. curvata* (pl. 48, fig. 12) and possessing a ventro-caudal lobe like that of *C. c. lira* (pl. 47, fig. 7), but much more concave dorsad of lobe, and strongly sclerotized proximad of lobe; more bristles than in the subspecies of *C. curvata*. With genal process wider above, as broad as last genal spine (pl. 48, fig. 1), not acuminate (pl. 48, fig. 7, and pl. 47, fig. 1); with first genal spine arising at border of head, not caudad a distance equal to breadth of spine. Eye vestigial and represented by outlines, not by a definite pigmented area. Male lacking antepygidial processes (pl. 48, fig. 4), but female (pl. 48, fig. 10) with processes as in *curvata* (pl. 47, fig. 11). Immovable process of clasper with base of *P1* close to *P2* (pl. 48, fig. 2) and lacking the small pointed projection between *P1* and *P2* that is present in *curvata* (pl. 48, fig. 8, and pl. 47, fig. 4). Distal arm of ninth sternum longer and more ovate (pl. 48, fig. 3), margins not slightly angulate as in *curvata* (pl. 48, fig. 9, and pl. 47, fig. 12). Aedeagus of same general type but with sagittate part of crochet (pl. 48, fig. 5, *CR.*) longer, more concave dorsally, and bearing a longer proximal acuminate thumb than in *curvata* (pl. 48, fig. 11, and pl. 47, fig. 6). Inner tube (pl. 48, fig. 5, *S.I.T.*) extending well distad of level of upper margin of crochet.

Host Relationships of Corrodopsylla

The fleas of the genus *Corrodopsylla*, like those of *Doratopsylla*, are true shrew fleas; they are very rarely found on other mammals, and then only on mammals that occupy the same habitat. In my opinion, the subspecies of *Corrodopsylla curvata* are probably characteristic parasites of *Sorex*. Almost all records cite this genus as the host. It is considered possible that the few records credited to *Blarina* represent strays. *C. c. curvata*, widely distributed in the western United States, ranges east at least as far as Vermont, where I have collected it on *Sorex*. Examination of more than fifty *Blarina* in the area failed to yield any *Corrodopsylla*, but they were heavily infested with *Doratopsylla blarinae* (C. Fox 1914). F. L. Osgood of Rutland, Vermont, who has collected intensively in the area, has never found *Corrodopsylla* on *Blarina*.

Doratopsylla blarinae is undoubtedly a true parasite of *Blarina* and is very common in the eastern United States. Surprisingly enough, *Blarina* in central Illinois are not parasitized by this species; instead, they carry *Corrodopsylla hamiltoni*. However, there is evidence to indicate that the latter is really a parasite of *Cryptotis*. The species is known to me from this host in both Missouri (Columbia, coll. W. R. Enns, March 11, 1947) and in New York (Ithaca). There are no records of this species from *Blarina* at Ithaca, despite intensive collecting. *D. blarinae* is common in that area.

Status of the Name Corrodopsylla

Wagner (1929b) originally proposed *Corrodopsylla* as a subgenus of *Doratopsylla* Jordan and Rothschild 1912; in 1936 he elevated it to generic status.

Ewing and Fox (1943) have accepted this status, but certain other authors apparently have not even accepted the subgeneric designation; Hubbard (1947) does not mention the name.

The aedeagus of *Doratopsylla blarinae* (see pl. 47, fig. 13) is quite different from that of *C. curvata* and *C. hamiltoni*. In my opinion, these differences, together with those originally cited by Wagner, suggest the valid use of *Corrodopsylla* as a generic name. However, the genotype—*D. dasycnemus* Rothschild—should be checked in this regard. In *D. blarinae* the lateral lobes (pl. 47, fig. 13, *L.L.*) are not subordinated by the enlarged crochets but are distinct on each side and extend to the median dorsal lobe (*M.D.L.*). The crochets (*CR.*) are separate for their entire length and are of a very different shape. The sclerotized sheath of the inner tube is associated with a specialized armature (*A.I.T.*) that is characterized by a row of minute but distinct denticules extending to near the apex of the lateral lobes. The wall of the aedeagal pouch (*P.W.*) is distinct, arising from the area well cephalad of the apodemal strut and with ventral margins well sclerotized. The aedeagal apodemal rod (*A.A.R.*) is well sclerotized.

Family PULICIDAE

Among the very interesting material collected on the Field Museum–Leon Mandel Expedition to Guatemala is a series of *Pulex* from a pocket gopher. As in other fleas characteristic of this subterranean host—for example, *Foxella* and *Dactylopsylla*—the eye is greatly reduced. Dr. Karl Jordan of the British Museum points out (in litt.) that the eye is very much smaller than in *Pulex irritans* L. from the New World and various countries of the Eastern Hemisphere. Because of this and other differences, these specimens are described as a new species.

Pulex sinoculus sp. nov. Plates 49, figs. 1–3; 50.

Near *Pulex irritans* Linnaeus but readily separated by the vestigial eye. Also distinct in that the aedeagal crochet is narrowed proximally and is subfusiform (pl. 49, fig. 3, *CR.*), instead of being much broader proximally than apically and suggesting a bent thumb (pl. 49, fig. 4, *CR.*). The hoodlike median dorsal lobe of the aedeagus (pl. 49, fig. 3, *M.D.L.* and *A.M.S.*) bears distinct apical sclerites on each side, instead of being feebly sclerotized (pl. 49, fig. 4, *M.D.L.*). The labial palpi (pl. 49, fig. 1, *L.P.*) are much shorter than in *irritans*, reaching only to the midpoint of the procoxae, and segment three is subequal in length to two, whereas in *irritans* the palpi extend three-fourths of the length of the procoxae and the apical segment is longer than the penultimate. The genal margin lacks the tooth so often present in *irritans*. The mesepisternum bears three bristles, not two. The apex of the distal arm of the male ninth sternum is broader, being about twice as broad as its diameter at the midpoint. The lobe dorsad of the sinus of the female seventh sternum is strongly sclerotized.

Male and Female: Head (pl. 49, fig. 1, male).—Fronto-clypeal margin evenly rounded, tubercle absent. Preantennal region with two bristles, one near insertion of maxillary lobe, the other ventrad of second antennal segment. Eye greatly reduced, represented only as an inconspicuous median oval spot on antennal groove. Maxillary lobe (*MX.*) extending to about apex of second segment of maxillary palpus (*M.P.*). Maxillary palpus with second segment scarcely longer than first and subequal to fourth; third segment smallest. Maxillary palpi serrate for most of their length. Scape of antenna slightly longer than broad, about as long as clavus, with small apical and subapical bristles. Second antennal segment about twice as broad as long, with apical, fairly long setae, one or two of these about as long as clavus. Annulations of clavus extending somewhat less than one-half the width of club. A row of very small bristles bordering dorso-caudal margin of antennal fossa. Postantennal region with but one bristle, this near ventro-caudal angle.

Thorax.—Pronotum with about five long bristles on each side, meso- and metanota with about six. Mesopleuron lacking the pleural ridge characteristic of most non-pulicine fleas, but its area apparently indicated by thickenings. Mesepisternum (*MPS.*) well developed, with a row of three long bristles. Mesepimeron (*MPM.*) reduced, lacking bristles. Lateral metanotal area with two or three bristles but with ventral margin not as clearly delimited as in non-pulicine species. Metepisternum about twice as broad as lateral metanotal area, with a single caudo-marginal bristle. Metepimeron with two rows of seven and six (or seven) bristles.

Legs.—Metacoxae with an irregular row of about nine small subapical spiniforms. Profemora with three or four small thin mesal median bristles. Meso- and metafemora with a mesal row of six or seven bristles. Measurements of male tibiae and segments of tarsi:

Leg	Tibia	Tarsal Segments				
		1	2	3	4	5
Pro-	208	64	64	57	38	157
Meso-	272	83	96	70	55	160
Meta-	415	230	144	100	67	180

With the exception of the fourth segment, all tarsal segments with apical bristles reaching to or beyond apex of following segment. Distal tarsal segment of each leg with four pairs of lateral plantar bristles and an apical pair of unequal length. Blade of unguis long and narrow, almost three times as long as thickened recurved basal portion; inner surface of blade and base grooved.

Abdomen.—First abdominal tergum with a total of about four dorsal bristles preceding the full row, which consists of three or four long bristles on each side. Abdominal terga with a row of about six bristles on each side, the rows not reaching the spiracles. Basal sternum with three or four small bristles. Sterna three to six with three longer bristles on each side. Males with middle antepygidial bristle well developed (pl. 49, fig. 2, *A.B.*), the dorsal and ventral bristles absent or vestigial; female (pl. 50, fig. 5, *A.B.*) similar.

Modified Abdominal Segments: Male (pl. 49, fig. 2).—Eighth tergum (*8 T.*) small, reduced to a narrow sclerite extending from sensilium to antepygidial bristles and ventrad to a level well dorsad of apex of proximal arm of ninth sternum (*P.A.9*); a short spur-like apodeme (*T.AP.8*). Eighth sternum (*8 S.*) extremely enlarged, extending dorsad to near spiracle and caudad beyond bases of movable fingers, thus enclosing much of genitalia; three bristles near angle of ninth sternum, two near insertion of lower movable finger and two at level of middle of distal arm of ninth sternum; a sclerotized line paralleling apico-ventral margin.

Immovable process of clasper (*P.*) very large, apical margin rounded and with a fringe of about sixteen bristles. Two movable fingers (*F1* and *F2*, and pl. 50, fig. 1) inserted at

proximal margin. *F1* dorsally sinuate and with two apical small bristles; ventral margin angled at apical third. *F2* more narrowed and curved dorsad apically, with about six marginal bristles on apical third and a submarginal bristle proximad of midpoint. Manubrium (*MB.*) with margins subparallel, apex broad and slightly rounded, slightly upturned. Ninth tergum (*9 T.*) reduced to a narrow sclerite extending from apex of proximal arm of ninth sternum to near dorsal margin of eighth tergum. Tergal apodeme of ninth segment (*T.AP.9*) very large, extending into manubrium and forming cephalo-dorsal part of claspers. Ninth sternum boomerang-shaped and well sclerotized. Proximal arm of ninth sternum (*P.A.9*) almost as long as distal arm (*D.A.9*); apically subtruncate. Distal arm (pl. 50, fig. 2) apically dilated and subovate, with a marginal fringe of about twelve bristles (the longest ventral) and a few submarginal or median bristles.

Aedeagus and aedeagal apodeme (pl. 49, fig. 3) of same general type as that of *P. irritans* (pl. 49, fig. 4). Aedeagal apodeme (*AE.A.*) expanded dorso-apically, producing what is here designated the fin (*FN.*); with a somewhat similar ventral expansion. Aedeagus proper with a hoodlike median dorsal lobe (*M.D.L.*) which on each side bears an irregular curved apical sclerite, here designated the apical medio-dorsal sclerite (*A.M.S.*). Ventral wall of aedeagus with two lateral rodlike thickenings, here called the runners (*RN.*) because of their similarity to the runners of a sleigh; the runners arise from the base of the wall of the aedeagal pouch (*P.W.*). A pair of articulated lateral sclerites at the ventro-apical margin of the endchamber, suggesting true crochets.[1] The true crochet single, dorsal in position and with its sclerotized portions fusiform but elbowed; the lightly sclerotized apex subtruncate. Lateral lobes (*L.L.*) reduced to apical subrectangular expansions of the sidewall of the endchamber; apically ridged. Sclerotic inner tube of aedeagus (*S.I.T.*) horizontal and consisting of two articulated sclerites (suggesting *Rhopalopsyllus, Polygenis* and allies, as well as other Pulicidae), these long, slender, tapering, and without armature. Apodemal strut supporting inner tube on each side consisting of the typical curved lateral ventral lobe (*L.S.*) and a more dorsal mesal sclerite (*M.S.*). Distad of the mesal sclerite, the crescent sclerite (*C.S.*) forms the dorsal wall of apparently what Sharif (1945) has described as the sperm-pumping apparatus. The ventral intramural rod and certain elements of the penis rods enter and apparently terminate in a subspherical sclerotized ventral lobe of the inner tube. This dilated structure (*V.*) is considered by me to be the vesicle, as in *Polygenis*. Ventral intramural rod of endophallus (*I.R.*) well developed, extending cephalad three-fourths of length of aedeagal apodeme. Penis rods (*P.R.*) very long and coiled like a spring. The third rod is a true aedeagal apodemal rod (*A.A.R.*) and does not arise from the ninth sternum. Tenth abdominal segment with a convex sensilium, but with proctiger feeble and difficult to see in cleared specimens.

Modified Abdominal Segments: Female (pl. 50, fig. 5).—Seventh sternum (*7 S.*) dorso-caudally concave, with a conspicuous, broad, caudal sinus, the lobe above the sinus somewhat narrowed; caudal portion strongly sclerotized. Seventh sternum with about five bristles in an irregular row. Eighth tergum (*8 T.*) with about ten scattered long median and subventral bristles and many more caudo-marginal bristles, some of which are quite small and many almost contiguous. Eighth sternum (*8 S.*) narrow, without bristles. Dorsal anal lobe (*D.A.L.*) large, broadened apically, with about six median bristles and three submarginal ones above insertion of anal stylet, and three marginal ones below. Anal stylet

[1] However, Snodgrass (1946) has shown that in *P. irritans* the single prominent flat hook arising from the dorsal wall of the endchamber bears two muscles, and he considers this to represent the true crochet of other species. *P. irritans*, as shown in pl. 49, fig. 4, also has a pair of articulated lateral ventro-apical sclerites in the position where one often finds crochets. Snodgrass figures these but does not mention them. These sclerites are designated by me as pseudocrochets (*PS.C.*) and are observed to be subapically expanded and apically narrowed in *P. sinoculus*, not apically expanded. Similar sclerites are found in other Pulicid genera known to me.

(*A.S.* and pl. 50, fig. 3) about three and one-half times as long as broad near base, with a short ventral bristle and a very long apical bristle. Ventral anal lobe (*V.A.L.* and pl. 50, fig. 4) subquadrate, widest at base, breadth at apex almost half of length; a proximo-dorsal bristle and about eleven subapical median and/ or marginal ones as shown in figure. Spermatheca (*SP.* and pl. 50, fig. 6) with head rounded, slightly longer than broad; tail longer than head, curved and rounded at apex.

Holotype.—A male from Tecpam, Department of Chimaltenango, Guatemala. Collected February 7, 1934, by F. J. W. Schmidt on the Field Museum–Leon Mandel Expedition to Guatemala. In the collection of Chicago Natural History Museum. Host: *Orthogeomys grandis* Thomas, a pocket gopher.

Allotype.—A female, same data and depository as the holotype.

Paratypes.—A long series, same data as the holotype, but some collected February 5, 1934; a long series, same data as the holotype, but from *Sciurus g. griseoflavus* Gray, February 2, 1934. In the collections of the United States National Museum, the Rocky Mountain Laboratory (Hamilton, Montana), the San Francisco Plague Laboratory, Cornell University, the Museum of Comparative Zoology at Harvard College, the Dominion Entomological Laboratory (Kamloops, British Columbia), the British Museum (Natural History), the Stavropol-Caucasus Parasitological Laboratory, U.S.S.R., and of Robert Traub, E. W. Jameson, and other collections.

Remarks.—The specific name is suggestive of the virtual absence of the eye.

PART II

THE COMPARATIVE MORPHOLOGY OF THE AEDEAGUS OF SIPHONAPTERA FROM MEXICO AND CENTRAL AMERICA

Comparative studies of the aedeagus have been neglected for various reasons. Certain details of the structure of the aedeagus cannot easily be ascertained—in fact, many features of the morphology are not yet understood—and other characters have been considered adequate for taxonomic purposes. Two recent comprehensive works on the classification of the North American fleas scarcely mention the aedeagus. However, there has been a recent tendency toward using it as a taxonomic aid, particularly by Jordan, who, as early as 1915–23, illustrated parts (though usually not labeled) in support of descriptions of new species. On the whole, it may be said that although certain apical lobes and proximal rods have at times been mentioned in descriptions, the taxonomic value of the aedeagus has never been fully exploited.

HISTORY OF THE STUDY OF THE AEDEAGUS

Sharif (1945, p. 81), in his very comprehensive treatment of the "so-called 'penis' of . . . *Ctenocephalides felis*," includes a brief history of the contributions that deal with the male genitalia of fleas; these are morphological papers and most of them do not deal with the aedeagus. Minchin (1915) published a somewhat detailed and illustrated account of the aedeagus of *Nosopsyllus fasciatus*. Unfortunately, he erred in his interpretation of the "spermatazoa." Pavlovsky (1926) described the internal genitalia of six species of fleas, and although the aedeagus was little emphasized, individual generic differences were observed; indeed, a brief generic key was prepared, using certain of these characters. Patton and Evans (1929, pp. 511, 522) briefly discussed the aedeagus of *Xenopsylla cheopis*. Great credit is due Jordan for his paper (1939) on the classification of *Rhopalopsyllus*. He described and figured the very highly modified aedeagi of three genera in this complex, and he also pointed out generic differences. Wagner (1940), in a consideration of the Old World species of *Ctenophthalmus*, made considerable use of the apical structure of the aedeagus; by this means he not only separated species, but helped to establish subgenera. Sharif (op. cit.) made an outstanding contribution in his detailed analysis of the genitalia of *C. felis*. For reasons listed below, I shall not follow Sharif's nomenclature.

I am indebted to Snodgrass, more than to any other worker, for having laid the framework of the present study. In his already classic work on the skeletal

anatomy of fleas (1946), he described and illustrated nine genera of North American fleas: *Ctenocephalides, Echidnophaga, Hystrichopsylla, Pulex, Dactylopsylla, Thrassis, Arctopsylla,* and *Monopsyllus* ("Trichopsylla"). In each case he included a discussion of the endophallus. His studies were based upon dissection of preserved specimens.

METHODS OF PREPARING THE AEDEAGUS FOR STUDY

All of the aedeagal characters mentioned in the following descriptions can frequently be seen in specimens prepared and mounted in the usual manner. If, in the mounting process, the aedeagus is partially extruded by sharp needles, the crochets are readily visible for their entire lengths. This is easily accomplished in certain genera, but in others the enlarged eighth sternum or the connecting ninth sternum may interfere. Bending back the claspers on one side prior to dehydrating the specimen is another means of more fully exposing the aedeagus. Dissection, of course, is most satisfactory, and when adequate material is available it is recommended that the aedeagus be routinely dissected out and separately mounted. Other specimens should be saved for study of the dorsal and ventral aspects. It has been found advisable, prior to dissection, to treat some specimens with a caustic such as 10 per cent potassium hydroxide; others of the series may first be softened in water or 2 per cent trisodium phosphate. These methods make possible the study of the endophallus and the wall of the aedeagal pouch, which cannot be seen in cleared material.

MORPHOLOGY OF THE AEDEAGUS[1]

According to Snodgrass, the intromittent organ of the male flea consists of three parts: an external aedeagus, a large basal apodeme, and an internal organ, the endophallus, which is invaginated from the aedeagus.

The aedeagus has its origin in a membranous pouch between the base of the tenth abdominal segment and the base of the ninth sternum. The basal wall of the aedeagal pouch (pl. 52, fig. 1, *P.W.*) can at times be seen in cleared specimens, and serves to separate aedeagus from aedeagal apodeme (*AE.A.*). The dorsal wall of the pouch is often associated with a sclerotization that extends across the top of the aedeagus. Because only the end of this structure is visible at one level, and it appears rodlike, I have called it the proximal spur (*P.S.*).

The apical part of the aedeagus is often cylindrical and expanded and/or deeply invaginated, forming what Snodgrass has termed the endchamber. The aperture is flanked or protected by various projections or lobes. Often there is a single median dorsal lobe (pl. 17, fig. 8, *M.D.L.*); sometimes there are two such lobes (pl. 44, fig. 3, *D.L.*). The median dorsal lobe may be simple (pl. 18, fig. 6),

[1] As noted before, the nomenclature employed by Snodgrass is followed in so far as is possible, because his work was based not only on a representative series of flea genera but on a thorough knowledge of the fundamentals of morphology and of other insect orders as well. For purposes of homology, I have given names to structures that were left unnamed by Snodgrass and to others that are noted here apparently for the first time.

bifid (pl. 52, fig. 4), flared and convoluted (pl. 27, fig. 4), divided into several lobes, or otherwise modified. At times there is a distinct sclerite on each side of the median dorsal lobe (pl. 41, fig. 4, *A.M.S.*). The lateral lobes (pl. 1, fig. 4, *L.L.*) are, as the name indicates, a pair of lobes lateral in position. They are short and apical in some genera (pl. 53, fig. 2), but in others they are long, arising as far cephalad as the apodemal strut. They may be relatively weakly or well sclerotized; sometimes their surfaces are ridged (pl. 49, fig. 4). At times the lateral lobes are fused on each side with the downward-hanging sides of the aedeagal pouch (pl. 52, fig. 4). Typically, there is a pair of movable hook-like sclerites, the crochets (pl. 52, fig. 4, *CR.*), which are lateral in origin. In certain groups of fleas, these are very large, projecting distad of the endchamber (pl. 52, fig. 3); in others, they are reduced and apparently scarcely movable (pl. 53, fig. 2), or feebly sclerotized, or absent (pl. 54, fig. 6). They are usually ventral but sometimes dorsal in insertion; their apices are usually narrowed and directed dorsad; in some cases the crochets are fused mesally (pl. 49, fig. 4). In many there is a stout, short, peg-shaped sclerotization near the point of articulation. The lobes noted above have been called parameres by certain authors, but Snodgrass has shown that the true parameres become the claspers.

In some groups of fleas, the sides of the endchamber are not protected by ventrally directed lateral lobes or by large crochets. Instead, the lateral lobes are apical, the crochets are practically internal, the floor of the aedeagus is very wide, the sides are unmodified. The Pulicidae are of this type. In these, the floor of the aedeagus may be ridged or thickened laterally by what I have called runners (pl. 54, fig. 4, *RN.*). There usually are subapical sclerites that resemble the crochets; I call these the pseudocrochets (*PS.C.*). Some of this group possess dorsal strengthening sclerites, here named ribs (pl. 53, fig. 1, *RB.*).

In the middle of the endchamber is the inner tube, which arises as an evagination of the inner wall. The inside wall of the tube, according to Snodgrass, is formed by invagination of the tube apex, and it leads directly to the endophallus. The sclerotized sheath of the inner tube is often highly modified. The so-called armature may consist of dorsal, ventral, or lateral bulges (pl. 51, fig. 3, *A.I.T.*), or of stout flanking sclerites (pl. 32, fig. 5). The sclerotized inner tube may consist of one segment (pl. 54, fig. 3) or of two distinct sclerites (pl. 38, fig. 6); it may be horizontal, vertical, or oblique in position; its apex may be expanded or winged (pl. 21, fig. 4, *A.S.I.*). The inner tube may be further protected by a latero-caudal or lateral sclerotization (pl. 52, fig. 2, *L.S.I.*). In some genera there is a pair of apical but unattached sclerites flanking or near the inner tube (pl. 51, fig. 3, *A.S.T.*). *Ctenocephalides* (pl. 53, fig. 2) possesses a dorsal sclerite (*D.I.T.*) that seems to be an arm of the sclerotic inner tube but that is readily separable under pressure. In certain species, a narrow band-like sclerotization extends distad of the apex of the sclerotic inner tube (pl. 54, fig. 1, *B.I.T.*). In some genera, there is a semimembranous extra-aedeagal extension of the inner tube (pl. 52, fig. 2, *E.I.T.*) that may actually be much longer than the endchamber.

The inner tube is supported near its base by the so-called apodemal strut, which arises from the middle plate of the apodeme. Apically the apodemal

strut (as seen in lateral aspect) usually consists of a pair of latero-ventral convex lobes (pl. 52, fig. 1, *L.S.*) and a pair of more dorsal, mesal subquadrate lobes (*M.S.*). At times there is a pair of irregular or acuminate dorsal lobes (*D.S.*). Between these lobes is a sclerite that arises from near the floor of the aedeagus and extends dorsad of the strut; the dorsal margin of this sclerite is stoutly sclerotized and flanged, usually crescentic in shape; often, only the crescentic dorsal margin is visible and hence I refer to it as the crescent sclerite (*C.S.*). The dorsal margin of the crescent sclerite seems to form the roof of what Sharif called the sperm-pumping apparatus. Snodgrass has shown that the sclerotic inner tube is movable on its strut in vertical plane, but that it cannot be extruded.

The apodeme of the aedeagus consists of three plates: a pair of arched lateral plates (pl. 52, fig. 3, *L.PT.*), which are joined dorsally, and a middle plate (pl. 51, fig. 2, *MI.P.*), which extends apicad to form the apodemal strut. The lateral plates at times continue forward alongside the median dorsal lobe as acuminate projections, here called the accessory lateral lobes (*A.L.L.*). In one genus studied, the lateral plates are markedly arched dorsad (pl. 42, fig. 4).

The highly complex endophallus need not be fully discussed here; few of its elements can be seen in prepared slides. Reference should be made to Snodgrass for details of its structure. Externally the endophallus is a thin-walled cylindrical sack that extends cephalad from about the base of the apodemal strut to the proximal ends of the penis rods; if the latter are coiled, as in some species, the sack follows the convolutions. The sack cannot be seen in cleared specimens. Two intramural rods strengthen the sack. The dorsal intramural rod (pl. 52, fig. 2, *D.I.R.*) is short and only occasionally sufficiently well sclerotized to be visible in cleared specimens. The ventral intramural rod (*I.R.*) is usually better sclerotized and longer. Muscles arising from these rods encircle the endophallus. Paralleling the ventral curvature, but free, is the third apodemal rod; this arises from the wall of the aedeagal pouch in some genera (pl. 51, fig. 4, *A.A.R.*); in others it lies loose in the pouch (pl. 51, fig. 3); in some (as in the ceratophyllids), it arises from the angle of the ninth sternum. The penis is an inner tube within the endophallus; within it, in turn, runs the ejaculatory duct, which arises from the vas deferens; the latter arises from the testes. The penis in copulation does not enter the female; penetration is effected by the long, narrow, often coiled penis rods (*P.R.*), which lie against the penis when *in situ*. The penis rods are visible in cleared fleas, and the extent of coiling is a useful taxonomic character. Outlines of the penis proper can often be seen in slide material.

COMPARATIVE MORPHOLOGY OF THE AEDEAGUS

The aedeagi of twenty-six genera that are known to occur in Central America or Mexico are discussed and figured herein. Snodgrass has already treated four of these; however, in each instance, he cited details of the endophallus, but did not discuss certain characters that are visible in cleared specimens. Since a prime purpose of this study is to emphasize the practicability of using the aedeagus for taxonomic purposes, I stress the structures that are visible in

cleared and/or mounted fleas and do not ordinarily discuss the endophallus, which, as I have already pointed out, cannot be seen in cleared material.

The genera treated are alphabetically grouped below, using a family nomenclature that is in part original as pointed out below.

I. Family HYSTRICHOPSYLLIDAE

- Genus *Corrodopsylla* Wagner, p. 96
- Genus *Ctenophthalmus* Kolenati, p. 97
- Genus *Doratopsylla* Jordan and Rothschild, p. 96
- Genus *Hystrichopsylla* Taschenberg, p. 95
- Genus *Stenoponia* Jordan and Rothschild, p. 93
- Genus *Strepsylla* gen. nov., p. 95

II. Family CERATOPHYLLIDAE

- Genus *Ceratophyllus* Curtis, p. 101
- Genus *Dasypsyllus* Baker, p. 104
- Genus *Diamanus* Jordan, p. 98
- Genus *Foxella* Wagner, p. 99
- Genus *Jellisonia* Traub, p. 103
- Genus *Kohlsia* gen. nov., p. 103
- Genus *Leptopsylla* Jordan and Rothschild, p. 105
- Genus *Nosopsyllus* Jordan, p. 99
- Genus *Opisodasys* Jordan, p. 102
- Genus *Orchopeas* Jordan, p. 100
- Genus *Pleochaetis* Jordan, p. 102
- Genus *Polygenis* Jordan, p. 105

III. Family ISCHNOPSYLLIDAE

- Genus *Myodopsylla* Jordan and Rothschild, p. 107
- Genus *Sternopsylla* Jordan and Rothschild, p. 108

IV. Family PULICIDAE

- Genus *Ctenocephalides* Stiles and Collins, p. 110
- Genus *Hoplopsyllus* Baker, p. 112
- Genus *Pulex* Linnaeus, p. 111
- Genus *Xenopsylla* Glinkiewicz, p. 109

V. Family HECTOPSYLLIDAE

- Genus *Echidnophaga* Olliff, p. 113
- Genus *Tunga* Jarocki, p. 114

The above list includes five of the six families that are recognized by Ewing and Fox (1943). The sixth—Stephanocircidae Wagner—occurs only in South America and Australia. Eleven of these genera are reported from Mexico and Central America for the first time. Three genera that are known to occur in this region are not discussed for lack of material. These are *Actenopsylla* Jordan and Rothschild 1923 (consisting of but one rare species), *Malaraeus* Jordan 1933, and *Tritopsylla* Cunha 1929. On the basis of aedeagal characters, as well as those of the modified abdominal segments, the family classification of two genera has been changed from that ordinarily used. I agree with Ewing and Fox that *Ctenophthalmus* shows more affinities with the Hystrichopsyllidae than with the Ceratophyllidae. On the other hand, I believe *Leptopsylla* to be a ceratophyllid rather than a hystrichopsyllid.

Family HYSTRICHOPSYLLIDAE

Genus **STENOPONIA** Jordan and Rothschild

Stenoponia Jordan and Rothschild, Proc. Zool. Soc. Lond., **1911**, p. 391, 1911.

Genotype: *Hystrichopsylla tripectinata* Tiraboschi 1902.

This holarctic genus is represented in North America by one species, *americana* (Baker 1899), which is fairly common on small rodents in eastern North America and seems to be collected almost entirely in the late fall or winter. There is one record from the West (Montana). Through the kindness of Dr. W. J. Gertsch and Dr. C. H. Curran, of the American Museum of Natural History, I have been able to study a female *Stenoponia* taken near Mexico City. Although there are indications that this specimen may actually represent an undescribed species, its status cannot be definitely ascertained from the single specimen. A discussion of the aedeagus of *americana* is of interest not only *per se*, but because of the comparisons it makes possible.

The aedeagal apodeme (pl. 51, fig. 3, *AE.A.*) is much more than twice the length of the part of the aedeagus that is apicad of the apodemal strut (*L.S.*), and is more than three times as long as broad. Apical appendage and proximal spur absent. Aedeagus proper broad at base, neck therefore absent, aedeagal pouch arising proximad of apodemal strut. Floor of aedeagus, as seen in lateral aspect, well sclerotized, its margins sinuate and extending ventrad and caudad to base of crochet. Distal region of aedeagus (the endchamber) covered by a long hood (*H.*) which is open apically and ventrally and extends ventrally cephalad as far as apodemal strut. The median dorsal lobe and lateral lobes characteristic of many other genera are absent. Aedeagal crochets (*CR.*) well developed, ventral, inserted well proximad of apex of hood but extending ventrad of hood; slightly longer than broad; somewhat resemble a pair of broad short talons with an abbreviated claw, a sinuate base and a long proximal spur. Armature of sclerotized sheath of inner tube (*A.I.T.*) relatively unspecialized; represented by a proximal ventral thickening and a slight dorsal hump. Sclerotized inner tube (*S.I.T.*) broad, horizontal; apex truncate and unadorned. Closely associated with dorso-apical half of inner tube are a crescentic sclerite and a pair of more apical subtriangular sclerites, the latter here designated the apical sclerites of the inner tube (*A.S.T.*). Apodemal strut supporting inner tube consisting of three lobes on each side: a curved latero-ventral lobe (*L.S.*), a somewhat longer mesal lobe (*M.S.*) and a broader, more triangular dorsal lobe (*D.S.*). Dorsad of strut a typical elongate curved sclerite, the crescent sclerite (*C.S.*). Penis rods (*P.R.*) extending cephalad only slightly beyond apex of aedeagal apodeme, uncoiled. Dorsal intramural rod of endophallus (*D.I.R.*) fairly well sclerotized, ventral intramural rod (*I.R.*) more so. The third apodemal rod a true aedeagal rod (*A.A.R.*), apparently lying free in endchamber.

The aedeagus of *Stenoponia*, at least in the North American species, may be characterized as follows: Aedeagal apodeme long, with apical appendage and proximal spur absent. Endchamber covered by a simple open hood. Specialized median dorsal lobe or lateral lobes absent. Crochets ventral, short but conspicuous, articulated. Sclerotized sheath of inner tube without special armature or apical expansions. Apical sclerites of inner tube present. Penis rods uncoiled. Aedeagal apodemal rod present, terminating in the well-developed aedeagal pouch, which is ventrally well sclerotized and arises well proximad of apodemal strut.

In certain important respects the aedeagus is of a primitive type. The hood may very well represent the precursor of the median dorsal lobe and lateral lobes of other genera. The ninth sternum apparently contributes little to the aedeagal armature; it has no apodemal rod and seems to have no sclerotized connections with the aedeagus. The sclerotized sheath of the inner tube is simple

in comparison with other genera, as will be shown. The apical sclerites of the inner tube may also be a primitive structure.

Genus **HYSTRICHOPSYLLA** Taschenberg

Hystrichopsylla Taschenberg, Die Flöhe, p. 83, 1880.

Genotype: *Pulex talpae* Curtis 1826.

The holarctic genus *Hystrichopsylla* is represented in North America by two or three species that are of interest for many reasons, including their relatively huge size and extreme variability. Most records are from the western part of North America, from California to Canada, but the genus is also known from the eastern United States, usually at higher elevations. In July, 1941, I collected a female from *Neotomodon alstoni* Merriam (a type of woodrat), taken at 10,500 feet altitude on Mount Tancítaro, in Michoacán, Mexico. This specimen is even larger than the forms found in the United States, and while near to *H. gigas dippiei* Rothschild 1902, exhibits definite variations. However, these differences cannot at present be properly evaluated. The genus is included in this paper because of this record. The following description of the aedeagus is based upon a study of cleared and mounted specimens of *H. gigas dippiei* from Utah, California, and Washington.

Aedeagus, including apodeme (pl. 51, fig. 4) very long and narrow, the portion cephalad of apodemal strut more than six times as long as wide at maximum, and more than twice as long as portion of aedeagus distad of apodemal strut. Apex of apodeme slightly narrowed, but apical appendage absent. Aedeagus with a conspicuous mid-dorsal trough, this extending to the relatively small aedeagal apodeme (*AE.A.*); broad at base, neck therefore absent. Aedeagus pouch arising proximad of base of trough, its floor extending ventrad and caudad to middle of inner tube; margin of floor sinuate in lateral aspect. Endchamber without specialized lobes, but covered by a simple hood which is open apically and ventrally and is weakly sclerotized. Aedeagal crochets (*CR.*) lying entirely within endchamber; reduced and modified, consisting of small subtruncate plates projecting from dorsal wall of endchamber. Armature of sclerotized sheath of inner tube (*A.I.T.*) consisting of a broad plate at proximal portion of inner tube and with a pair of arms extending dorso-apicad. The sclerotized inner tube (*S.I.T.*) is thick-walled, horizontal, and dorsally slightly sinuate. Apical sclerites of inner tube (*A.S.T.*) a pair of ovoid sclerites near apex of tube. Apodemal strut (*L.S.*, *M.S.*, and *D.S.*), crescent sclerite (*C.S.*), penis rods (*P.R.*), ventral intramural rod of endophallus (*I.R.*) as in *Stenoponia*. Aedeagal apodemal rod (*A.A.R.*) lying free in aedeagal pouch, but associated with margin of pouch.

Important structures of the aedeagus of North American *Hystrichopsylla* are as follows: Long and narrow structure. Apical and proximal spur absent. Aedeagal pouch very proximad in origin. Endchamber covered by a simple open hood. Crochets dorsal, probably not freely articulated. Armature of inner tube represented as a proximal plate with dorsal arms, but inner tube otherwise unspecialized. Apical sclerites of inner tube present. Penis rods uncoiled. Aedeagal apodemal rod present. The aedeagus is considered primitive in the same respects as noted for *Stenoponia*.

STREPSYLLA gen. nov. (p. 75)

Genotype: *Strepsylla mina* sp. nov. (p. 77)

The genus *Strepsylla*, as pointed out in the description above, belongs to the complex that includes *Phalacropsylla* Rothschild, *Epitedia* Jordan and related genera. Two species are known, both of them new. The aedeagus of this genus may be briefly characterized as follows:

Aedeagus proper subequal in length to aedeagal apodeme (pl. 44, fig. 3, *AE.A.*). Apical appendage absent. Aedeagal pouch very broad, with wall (*P.W.*) arising far cephalad of apodemal strut. Floor of aedeagus well sclerotized, fairly straight and extending to base of crochets. Crochets apico-ventral in insertion, extending slightly apicad of endchamber. Lateral lobes (*L.L.*) arising from dorsal and ventral walls of endchamber and extending distad of endchamber. With short apical truncate disto-dorsal lobes (*D.L.*), subapical dorsal lobes (*S.D.L.*), which are articulated, and paired median dorsal lobes (*M.D.L.*). Sclerotized inner tube (*S.I.T.*) short, horizontal, unspecialized. Apical sclerites of inner tube (*A.S.T.*) present. Ventral intramural rod (*I.R.*) well developed. Penis rods uncoiled. Aedeagal apodemal rod (*A.A.R.*) well developed.

Genus **CORRODOPSYLLA** Wagner

Doratopsylla (*Corrodopsylla*) Wagner, Konowia, 8, p. 317, 1929.

Corrodopsylla Wagner, Can. Ent., **68**, p. 205, 1936.

Genotype: *Doratopsylla curvata* Rothschild 1915.

The genus *Corrodopsylla* is known in Mexico only from a new subspecies of *curvata* (Rothschild). The aedeagus in this genus, as studied from mounted specimens, is quite distinctive.

Aedeagal apodeme longer than aedeagus. Apical appendage absent. Proximal spur very weakly developed. Median dorsal lobe (pl. 47, figs. 3 and 6, *M.D.L.*) very broad, dorsal margin evenly rounded. Lateral lobes (*L.L.*) relatively reduced to narrow structures terminating near apex of crochet. Crochets (*CR.*) very broad, apparently fused along mesal margin, at least apically. Sclerotized inner tube narrow, fairly long, vertical, unspecialized except for a caudal row of micro-denticulations. Sclerotized inner tube arising from a stout base (*A.I.T.*) that may represent the armature of the inner tube. Penis rods uncoiled. Aedeagal apodemal rod not apparent, probably because of feeble sclerotization. The ninth sternum definitely lacks an apodemal rod. Wall of aedeagal pouch too weakly sclerotized to be readily visible.

Although the aedeagus of *Corrodopsylla curvata* is apparently primitive in certain characteristics (for example, the simple inner tube), it is modified in others. The broad fused crochets are conspicuous. The lack of sclerotization of the aedeagal apodemal rod is noteworthy, and parallels the occurrence of unsclerotized portions of the ninth sternum.

Certain authors consider *Corrodopsylla* to be merely of subgeneric rank in the genus *Doratopsylla* Jordan and Rothschild 1912. However, in the United States form, *Doratopsylla blarinae* C. Fox, the aedeagus is quite different in certain respects, as was pointed out earlier in this paper. The lateral lobes (pl. 47, fig. 13, *L.L.*) are distinct on each side and extend to the median dorsal lobe (*M.D.L.*). The crochets (*CR.*) are separate for their entire lengths and are different in shape. The armature of the sclerotized inner tube (*A.I.T.*) is adorned with a recurved row of denticules. The aedeagal apodemal rod and the wall of the aedeagal pouch are well sclerotized. It is unfortunate that specimens of

D. dasycnemus Rothschild could not be obtained for verification of these characters.

Genus **CTENOPHTHALMUS** Kolenati

Ctenophthalmus Kolenati, Parasit. Chiropt., p. 33, 1856.

Genotype: *Ctenophthalmus bisoctodentatus* Kolenati 1863.

The following description of the aedeagus is based on New World material. Except for *C. pseudagyrtes*, only mounted and cleared specimens were available for study.

The aedeagal apodeme (pl. 40, fig. 3) is unique, among the genera studied, in that the lateral plates are arched dorsad into a sail (*S.*), the sails almost contiguous. The apical appendage and proximal spur are absent. The base of the aedeagal pouch encircles the aedeagus as a sclerotized girdle (*G.*) at the level of the midpoint of the sail, far cephalad of the apodemal strut. The walls ventrally are directed mesad, and are fused to form a characteristic keel (*K.*). The lateral lobes (*L.L.*) are somewhat elongate and proximally narrow, not covering the penis rods. The median dorsal lobe (*M.D.L.*) is arched and is paired apically, with distinct apical sclerites (*A.M.S.*). The crescent sclerite (*C.S.*) is relatively long, longer than the lateral ventral sclerite of the apodemal strut. The sclerotized inner tube is horizontal, long, consisting of dorsal and ventral elongate, subtriangular sclerites (pl. 40, fig. 5, *D.S.I.*, *V.S.I.*). The armature of the sclerotized sheath of the inner tube (*A.I.T.*) is relatively unspecialized. The apex of the sclerotic inner tube (*A.S.I.*) is simple. The crochets (*CR.*) are relatively small, not extending distad of the endchamber. The third apodemal rod arises among the two penis rods, not from the angle of the ninth sternum. The penis rods are uncoiled.

The genus *Ctenophthalmus* has frequently been placed in the Ceratophyllidae. However, the aedeagus resembles that of the Hystrichopsyllidae in the following respects: The proximal origin of the aedeagal pouch; the horizontal, relatively unarmed, sclerotic inner tube; the relatively short crochets; the absence of an apodemal rod arising from the angle of the ninth sternum. Other hystrichopsyllid characters have been mentioned elsewhere. For these reasons, the genus *Ctenophthalmus* is considered here as belonging to the family Hystrichopsyllidae.

The Aedeagus of Hystrichopsyllid Genera

Certain workers regard some of the genera of the Hystrichopsyllidae—for example, *Hystrichopsylla* and *Stenoponia*—as being primitive, though perhaps not as primitive in some characters as the Stephanocircidae. The evidence for this belief is not only morphological (such as the presence of two spermathecae), but also biological (based upon the phylogenetic position of the hosts). It is therefore interesting to note some generalizations about the aedeagus of these and other hystrichopsyllid genera.

In both *Stenoponia* and *Hystrichopsylla*, specialized lobes such as the median dorsal lobe and the lateral lobes are absent. Instead, the endchamber is covered by a simple hood that is open apically and ventrally. The pair of sclerites here called the apical sclerites of the inner tube is present in both genera and may also be primitive. The two genera also have very long aedeagal apodemes. These,

and the other hystrichopsyllid genera cited, agree in the following: Crochets short or relatively short, neither very much longer than broad nor extending far from endchamber. Aedeagal pouch relatively very long, arising well proximad of apodemal strut, with latero-ventral margins usually well sclerotized, probably open ventrally for the most part. Third apodemal rod arising from aedeagal pouch wall or lying free in pouch; not arising from ninth sternum. Sclerotic inner tube without armature or feebly armed, usually horizontal, with apex simple. Apical appendage absent. Proximal spur usually inapparent.

Family CERATOPHYLLIDAE

Genus **DIAMANUS** Jordan

Diamanus Jordan, Nov. Zool., **39**, p. 73, 1933.

Genotype: *Ceratophyllus montanus* Baker 1895.

In North America this genus is represented only by the genotype, which has a wide distribution in western Mexico and the far western United States. The usual host is *Citellus*.

In *D. montanus*[1] the aedeagal apodeme (pl. 52, fig. 3, *AE.A.*) consists of the usual three plates: the well-sclerotized middle plate which terminates in the apodemal strut, and the lateral plates (*L.PT.*) (difficult to see in cleared specimens) which extend apicad to base of apodemal strut. Apodeme broadest at proximal fourth; region cephalad of apodemal strut about four times as long as broad; a long apical appendage (*AP.A.*) and a much shorter proximal spur (*P.S.*); extended over aedeagus as a subacute accessory lateral lobe (*A.L.L.*), somewhat narrowed proximad of apodemal strut, forming a short thick neck (*N.*). Wall of aedeagal pouch (*P.W.*) arising at level of proximal spur, extending ventrad of penis rods and then curving apicad to base of lateral lobes. Endchamber relatively short, distance from base of apodemal strut to tip of median dorsal lobe less than half the length of aedeagal apodeme. Floor of aedeagus narrow; runners and pseudocrochets absent. Median dorsal lobe (*M.D.L.*) long, fairly straight dorsally, apically produced into a short hook and then recurved ventrad; an apical short curved marginal sclerite (*A.M.S.*) on each side. Lateral lobes (*L.L.*) greatly developed, extending from an area ventrad and proximad of apodemal strut to apex of median dorsal lobe; ventral margin convex; caudal margin deeply sinuate. Crochets (*CR.*) very well developed, almost as broad as aedeagal apodeme at maximum and about as long as dorsal margin of *M.D.L.*; dorsal and caudal margins produced apicad as a tongue-like extension, tongue as long as rest of crochet; almost as broad as long at maximum; a peg-like sclerotization at ventral third. Armature of sclerotized sheath of inner tube (*A.I.T.*) highly specialized, consisting of a dorsal and a ventral arm; dorsal arm dorsally angled and directed apicad, and, at the end of that extension, a caudal process at right angles; ventral arm with a narrow apical process. Sclerotized inner tube (*S.I.T.*) very short, consisting of one sclerite, truncate, and located between the armature arms; directed almost vertically. Apical sclerites of inner tube absent. Apodemal strut consisting of the typical curved latero-ventral sclerite (*L.S.*), a broad subovate mesal lobe (*M.S.*) and a subglobular dorsal sclerite (*D.S.*). Crescent sclerite (*C.S.*) with crescent short but well developed. Penis rods (*P.R.*) very long, not expanded proximally, coiled proximally into more than one complete turn for one spring, almost a complete turn for the second. Ventral intramural rod (*I.R.*) well developed. Vesicle absent. Third apodemal rod arising from angle of ninth sternum, not aedeagal in origin.

[1] Preserved specimens kindly sent by Dr. W. J. Jellison of the Rocky Mountain Laboratory, and cleared specimens from Mexico were studied.

The following aedeagal characters are important to note: Presence of apical appendage and proximal spur. Indications of a neck. Accessory lateral lobes. Shortened endchamber, with extremely well-developed long crochets and lateral lobes. Wall and floor of aedeagal pouch lightly sclerotized; pouch relatively short. Long median dorsal lobe with apical sclerites. Subvertical, short, unsegmented sclerotized truncate inner tube with prominent armature arms. Penis rods coiled; not expanded proximally. Third apodemal rod arising from ninth sternum.

Genus **NOSOPSYLLUS** Jordan

Nosopsyllus Jordan, Nov. Zool., **39**, p. 76, 1933.

Genotype: *Pulex fasciatus* Bosc 1801.

Nosopsyllus fasciatus is probably widely but discontinuously distributed on *Rattus* in Mexico and Central America. The aedeagus of this species demonstrates some noteworthy modifications.

Aedeagal apodeme (pl. 52, fig. 2, *AE.A.*) about four times as long as broad at maximum —length measured from base of apodemal strut to base of long apical appendage (*AP.A.*). Accessory lateral lobes (*A.L.L.*) prominent, fairly broad at base and covering dorsal margin of constricted area or neck. Portion of aedeagus distad of base of apodemal strut less than half of length of apodeme. Proximal spur (*P.S.*) present. Median dorsal lobe (*M.D.L.*) short, acuminate. Apical medio-dorsal sclerites (*A.M.S.*) well developed. Basal wall of aedeagal pouch (*P.W.*) arising at level of base of proximal spur and near origin of ventral convexity of middle apodemal plate and then extending to apodemal strut. Lateral lobes (*L.L.*) convex, extending from apodemal strut to apex of median dorsal lobe. Crochets (*CR.*) large, relatively weakly sclerotized, especially dorsally; a short truncate dorsal lobe; an elongate peg-like sclerotization near proximo-ventral angle. Armature of sclerotized sheath of inner tube (*A.I.T.*) specialized, consisting of two conspicuous lobular sclerotizations on cephalic margin. Apex of sclerotic inner tube subtruncate, expanded as much as lobes of sheath. Lateral sclerotization of inner tube (*L.S.I.*) very long. Inner tube extended as a long narrow sclerotized band (*B.I.T.*) which curves ventrad and cephalad to base of apodemal strut and then is further extended as a semimembranous extra-aedeagal tube (*E.I.T.*) which is recurved and continues caudad past base of crochets. Apodemal strut with a long curved latero-ventral sclerite (*L.S.*) and a stouter, more dorsal, longer mesal sclerite (*M.S.*). Two crescentic sclerites dorsad of apodemal strut, the uppermost probably associated with *A.I.T.*, the lower the true crescent sclerite. Ventral intramural rod (*I.R.*) and dorsal intramural rod (*D.I.R.*) present. Penis rods (*P.R.*) fully coiled.

In *N. fasciatus*, the following aedeagal characters merit comment: Presence of apical appendage and proximal spur, well-developed accessory lateral lobes, and dorsal intramural rod. Lateral lobes relatively short, but extending to apex of short median dorsal lobe. Specialized armature of inner tube, including expanded apex and long lateral sclerotization. Crochets, although large, feebly sclerotized. Enormous length of extra-aedeagal tube. Coiled penis rods. Aedeagal apodemal rod absent.

Genus **FOXELLA** Wagner

Foxella Wagner, Konowia, **8**, p. 314, footnote, 1929.

Genotype: *Pulex ignotus* Baker 1895.

The genus *Foxella*, characteristic fleas of pocket gophers, is represented in Mexico by two known species. Only the male of *hoogstraali* sp. nov. is known. The aedeagus of this species (pl. 34, fig. 5) and that of *F. i. ignota* from the United States (pl. 34, fig. 6)—both studied from cleared specimens—are similar in certain respects.

Aedeagal apodeme (*AE.A.*) long and narrow. Apical appendage (*AP.A.*), proximal spur (*P.S.*), and neck (*N.*) present. Lateral lobes (*L.L.*) well developed, median dorsal lobe (*M.D.L.*) simple and unflared, apex subtruncate. Crochets (*CR.*) very large, extending far distad of endchamber. Sclerotic inner tube subvertical, short, with complicated armature (*A.I.T.*) and modified apex (*A.S.I.*). Apodemal strut, ventral intramural rod and apodemal rod much as in *Pleochaetis*. Penis rods (*P.R.*) uncoiled.

The aedeagus of *Foxella* is fundamentally similar to that of other ceratophyllids, but the sclerotized sheath of the inner tube is highly modified.

Genus **ORCHOPEAS** Jordan

Orchopeas Jordan, Nov. Zool., **39**, p. 71, 1933.

Genotype: *Pulex howardii* Baker 1895 (through synonymy;=*Pulex wickhami* Baker 1895).

The genus *Orchopeas* is well represented in the United States and Canada and is known from Nuevo Leon, Mexico. The following description of the aedeagus is based upon dissections of *O. leucopus* (Baker 1904).

Aedeagal apodeme (pl. 51, fig. 2, *AE.A.*) consisting of a relatively narrow middle plate (*MI.P.*) that becomes deeply concave near apodemal strut, and two lateral plates that are produced into a dorsal pointed spur (*D.S.L.*) at the level of the apodemal strut. Other elements of lateral plates extending apicad as a thin, straight sclerotization, but true accessory lateral lobes absent. Region of apodeme cephalad of apodemal strut relatively long, more than six times as long as broad at maximum and about three times the distance from base of apodemal strut to apex of median dorsal lobe. Apex of apodeme slightly upturned, but apical appendage absent. Wall of aedeagal pouch (*P.W.*) sclerotized, arising at base of proximal spur (*P.S.*), ventrally strongly convex and then extending apicad to apodemal strut. Dorsal spur of lateral plate associated with aedeagal pouch wall. Neck region not apparent because of development of dorsal spur of lateral plate. True runners and pseudocrochets absent. Median dorsal lobe evenly convex, apically acuminate. Apical mediodorsal sclerite represented by a semimembranous structure. Lateral lobes (*L.L.*) extremely reduced, apparently represented as a semimembranous short spiculose lobe near base of crochets.[1] Crochets (*CR.*) beak-shaped, large, extending well apicad of median dorsal lobe; somewhat longer than broad; ventral margin slightly concave, dorso-caudal margin slightly sinuate, apex pointed; a lateral median peg-like sclerotization with an expanded base. Armature of sclerotized sheath of inner tube reduced to a lateral micro-tubercle. Sclerotized inner tube (*S.I.T.*) subrectangular, almost vertical, of one sclerite, short. Apex of sclerotic inner tube (*A.S.I.*) subtruncate and expanded, with a recurved cephalic process and an acuminate caudal process which apparently is accompanied by an extension of the inner tube, the caudal processes thus appearing bifid. Apical sclerites of inner tube absent. Apodemal strut (*L.S.*, *M.S.*, *D.S.*) and ventral intramural rod (*I.R.*) as in *Diamanus*. Penis rods (*P.R.*) not coiled. Vesicle absent. Third intramural rod arising from angle of ninth sternum; not aedeagal in origin.

[1] In the closely related *O. howardii* (Baker 1895) the lateral lobes are more sclerotized and extend more dorsad.

The important features in this genus are as follows: Development of proximal spur, and of dorsal spur of lateral lobe. Reduction of accessory lateral lobe and of true lateral lobes. Single median dorsal lobe. Well-developed, large, beak-shaped crochets. Strongly convex ventral margin of sclerotized wall of aedeagal pouch. Subvertical, short, unsegmented, sclerotized inner tube with reduced armature and expanded apex. Inner tube slightly projecting distad. Penis rods not coiled, not expanded apically. Third apodemal rod arising from ninth sternum.

Genus **CERATOPHYLLUS** Curtis

Ceratophyllus Curtis, British Ent., 9, p. 417, 1829.

Genotype: *Ceratophyllus hirundinis* Curtis 1832.

The genus *Ceratophyllus*, as used in its present restricted sense, includes a number of holarctic species, most of which are undoubtedly bird fleas. *C. gilvus* Jordan and Rothschild 1922, described from a swallow in Mexico, is known only from the original pair, which is not available for study. The aedeagus of *C. riparius* Jordan and Rothschild 1920, a species that is widely distributed in the United States and Canada, demonstrates characters that are probably typical of the genus. It is described below.

Aedeagal apodeme (pl. 52, fig. 4, *AE.A.*) long and narrow; region cephalad of base of apodemal strut about seven times as long as broad at maximum, excluding the long apical appendage (*AP.A.*); more than three times the distance from the base of the apodemal strut to the apex of the median dorsal lobe. Apodeme narrowed cephalad of base of apodemal strut, forming a neck (*N.*). Wall of aedeagal pouch arising as far cephalad as the proximal spur (*P.S.*); ventral margin on each side proximally straight, diverging, then fusing with lateral lobe (*L.L.*) on each side, the two serving as a joint ventro-apical flap protecting the aedeagus. The pouch wall apparently extends to near apex of sclerotized inner tube, but the lateral lobes continue to apex of median dorsal lobe. Accessory lateral lobe (*A.L.L.*) present, but very narrow. Median dorsal lobe (*M.D.L.*) bifid apically. Crochets (*CR.*) very long, longer than endchamber; somewhat flask-shaped, apically long and narrow, acuminate, slightly arched; proximally expanded, with margins somewhat rounded. Crochets proximally associated with somewhat filamentous or spiculose membranous structure, which in dissections of specimens untreated with caustic potash is seen to cover most of the apical portion of the aedeagus. Sclerotized sheath of inner tube vertical, apically dilated. Armature of sclerotized sheath of inner tube (*A.I.T.*) reduced to a subapical lobed expansion on cephalic portion. Apex of sclerotic inner tube (*A.S.I.*) expanded, concave; cephalic margin rounded. Inner tube remarkable in being extended as a long slender thin-walled extra aedeagal tube (*E.I.T.*), which curves ventrad near origin and extends cephalad as far as base of aedeagal pouch. Other characters as in *Orchopeas*.

Important characters in this genus are: Development of apical appendage and proximal spur. Reduction of accessory lateral lobe. Fusion of the very well-developed lateral lobes with the latero-apical walls of the aedeagal pouch. Straight proximo-ventral margin of aedeagal pouch. Proximal origin of lateral lobes. Median dorsal lobe apically bifid. Very large crochets that are longer than endchamber, apically curved and acuminate. Vertical sclerotized inner tube with apex expanded. Inner tube developed as a very long semimembranous extra aedeagal tube. Penis rods uncoiled. Third apodemal rod arising from

ninth sternum. Absence of pseudocrochets, runners, apical medio-dorsal sclerites, vesicle, apical sclerites of inner tube.

Genus **OPISODASYS** Jordan

Opisodasys Jordan, Nov. Zool., 39, p. 72, 1935.

Genotype: *Ceratophyllus vesperalis* Jordan 1929.

The genus *Opisodasys*, well known in the United States and Canada, is represented in Mexico by several species. The aedeagus of *O. hollandi* Traub 1947 was described in some detail in the original description. Major characteristics of that species, as seen in a study of cleared and mounted specimens, are as follows:

Aedeagal apodeme long and narrow. Absence of true accessory lateral lobes, the lateral apodemal plates extending as far apicad as the height of convexity of the single median dorsal lobe. Proximal spur not apparent in the single specimen available for study. Crochets (pl. 54, fig. 1,[1] *CR.*) extremely large, covering ventro-lateral portion of endchamber, and with a ventrad-directed long arm. Lateral lobes (*L.L.*) very well developed, curving ventrad of apodemal strut and extending dorsad to apex of lateral apodemal plate. Lateral lobes probably associated at base with wall of aedeagal pouch. Sclerotized sheath of inner tube apically armed on each side with a proximal rod-like sclerotization joined to a distal longer hooklike structure. Sclerotized band of inner tube (*B.I.T.*) present. Penis rods (*P.R.*) not coiled. Third apodemal rod arising from ninth sternum.

Opisodasys shows no radical changes from the typical ceratophyllid type of aedeagus. The very large lateral lobes and a highly modified sclerotized sheath of inner tube are characteristic.

Genus **PLEOCHAETIS** Jordan

Pleochaetis Jordan, Nov. Zool., 39, p. 77, 1933.

Genotype: *Ceratophyllus mundus* Jordan and Rothschild 1922.

The genus *Pleochaetis* Jordan (s. str.) is well represented in Mexico and Central America. In fact, all the evidence indicates that it is one of the most characteristic genera parasitizing wild rodents in the higher altitudes. There are two types of aedeagi in the genus as above defined by me.

In *P. sibynus* and its allies, the aedeagal apodeme (pl. 10, fig. 4, *AE.A.*) is convex dorsally and ventrally and bears a long apical appendage (*AP.A.*). Accessory lateral lobes are not apparent. The crochets (*CR.*) are subrectangular. The apex of the sclerotized inner tube (*A.S.I.*) is flattened and expanded, and the semimembranous extra-aedeagal tube is extended far distad. The apodemal strut consists of a latero-ventral sclerite (*L.S.*) and a more dorsal mesal sclerite (*M.S.*). The penis rods (*P.R.*) are coiled at least once.

In the genotype, *P. mundus*, and its allies, the aedeagal apodeme (pl. 23, fig. 4, *AE.A.*) has subparallel sides and only a short apical appendage (*AP.A.*). The crochets (*CR.*) are distally beak-shaped. Narrow but true accessory lateral lobes (*A.L.L.*) are present. The sclerotized inner tube has the apex (*A.S.I.*) recurved and bears a narrow sclerotized band (*B.I.T.*) extending distad, along with the semimembranous extra-aedeagal portion. The penis rods (*P.R.*) are uncoiled. The apodemal strut consists of three sclerites (*L.S.*, *M.S.*, and *D.S.*).

[1] Drawn to five-eighths the scale used in other figures.

The genus as a whole is further characterized as follows: Median dorsal lobe (pl. 10, fig. 4, *M.D.L.*) short, curved, acuminate, and lacking apical sclerites. Middle plate of apodeme markedly concave cephalad of the well-developed neck (*N.*). Lateral lobes (*L.L.*) well developed, usually convex and extending from region ventrad of apodemal strut to near apex of median dorsal lobe. Wall of aedeagal pouch not clearly visible in the specimens studied (all had been cleared), but apparently arising at level of proximal spur (*P.S.*) and extending to lateral lobes. Crochets (*CR.*) very large, extending far distad of endchamber. Sclerotized inner tube complicated, at least with respect to modifications at apex (*A.S.I.*) and the long lateral sclerotization (*L.S.I.*). Ventral intramural rod (*I.R.*) well developed. Aedeagal apodemal rod absent.

The two groups of species show differences in other features of the genitalia, as well as in the aedeagus. Further study may warrant the creation of subgenera along the lines suggested.

KOHLSIA gen. nov. (p. 45)

Genotype: *Kohlsia osgoodi* sp. nov. (p. 46).

The genus *Kohlsia*, as pointed out above, belongs in the *Pleochaetis* complex of genera. The aedeagus (pl. 27, fig. 4) of the genus is quite characteristic, due to the absence of an apical appendage and neck and because of the expanded, flared, and convoluted median dorsal lobe (*M.D.L.*). The accessory lateral lobes (*A.L.L.*) are well developed. The armature of the sclerotized sheath of the inner tube (*A.I.T.*) is specialized in various ways. The crochets (*CR.*) are as broad as long, or broader, and often subconical. Dorsal intramural rod (*D.I.R.*) often well sclerotized. Other characters as in *Pleochaetis*.

Genus **JELLISONIA** Traub

Jellisonia Traub, Field Mus. Nat. Hist., Zool. Ser., **29**, p. 211, 1944.

Genotype: *Jellisonia klotsi* Traub 1944.

The genus *Jellisonia* is known from Mexico and the southwestern United States. Five species have been described. The following description of the aedeagus is based upon a study of cleared and mounted specimens of the four species for which males are known.

The males can be separated into two groups upon aedeagal characters, as well as other features. Thus, in *klotsi* and *hayesi* sp. nov. the median dorsal lobe (pl. 1, fig. 4, *M.D.L.*) is simple and the accessory lateral lobe is not apparent. In *bullisi* (Augustson) and *ironsi* (Eads) the median dorsal lobe (pl. 8, fig. 4, *M.D.L.*) is apically bifid and there are well-developed accessory lateral lobes (*A.L.L.*).

In all species true lateral lobes (pl. 1, fig. 4, *L.L.*) extremely long and well developed. Aedeagal pouch wall not apparent in cleared specimens. Aedeagal apodeme (*AE.A.*) fairly long and narrow, the portion cephalad of proximal spur subequal to portion apical (*AED.*) of spur. Apodeme with a conspicuous apical appendage. Middle plate of apodeme deeply concave cephalad to apodemal strut. Crochets (*CR.*) large, extending far apicad of endchamber, with apex rugged, micromucronate. Armature of sclerotized inner tube (*A.I.T.*) highly specialized, of various shapes but flanking inner tube (*I.T.*) subapically. Sclerotized inner tube (*I.R.*) short, vertical. Penis rods (*P.R.*) uncoiled. Ventral intramural rod well sclerotized. Aedeagal apodemal rod absent.

Important characters in *Jellisonia* are the following: Presence of apical appendage and proximal spur. Presence or absence of accessory lateral lobes. Median dorsal lobe simple or bifid. Extremely long, stout lateral lobes. Crochets large, apically rugged. Sclerotized inner tube short, vertical but with highly specialized armature.

Genus **DASYPSYLLUS** Baker

Dasypsyllus Baker, Proc. U. S. Nat. Mus., **29**, p. 129, 1905.

Genotype: *Ceratophyllus gallinulae perpinnatus* Baker 1904.

D. gallinulae perpinnatus (Baker 1904) is widely distributed near the Pacific coast of the United States and Canada. The genus occurs in South America, and I have an El Salvador female that cannot be definitely assigned to species. Dr. H. S. Fuller states (in litt.) that he has a new species of *Dasypsyllus* from Venezuela. The genus therefore may be widely distributed in Central America and Mexico. The following description is based upon preserved and cleared specimens of the genotypic species kindly sent by G. P. Holland of the Canada Department of Agriculture.

Aedeagal apodeme (pl. 52, fig. 1, *AE.A.*) very long, that portion of the aedeagus cephalad of the base of the apodemal strut more than five times the maximum width and more than twice the length from base of apodemal strut to apex of crochets. Apical appendage (*AP.A.*) present. Proximal spur (*P.S.*) very well developed. True neck absent. Lateral apodemal plate with dorsal margin extending over apodemal strut as a very narrow accessory lateral lobe (*A.L.L.*). Basal wall of aedeagal pouch (*P.W.*) arising at level of base of proximal spur, ventral margin strongly convex and extending to level of apodemal strut. Median dorsal lobe (*M.D.L.*) apically bifid; projecting ventrad medially. Apical medio-dorsal sclerites absent. Lateral lobes (*L.L.*) well developed, extending on each side as a slightly sinuate, mainly convex lobe from apex of pouch wall to apex of median dorsal lobe. Crochets (*CR.*) very large, more than half as broad as endchamber and almost twice as long as broad; dorsal and ventral margins concave, apex oblique but subtruncate; a stout peg-like sclerotization near proximo-ventral angle. Armature of sclerotized sheath of inner tube (*A.I.T.*) specialized, consisting of a relatively long, horizontal, acuminate sclerite roughly paralleling the stout, slightly arched apex of the sclerotic inner tube (*A.S.I.*). Lateral sclerotization of inner tube (*L.S.I.*) well developed, elongate. Apex of sclerotized inner tube extending distad as a long curved narrow band (*B.I.T.*) that extends ventrad and cephalad to base of apodemal strut. Extra-aedeagal semimembranous inner tube (*E.I.T.*) arising near apex of *L.S.I.* and paralleling *B.I.T.* Apodemal strut (*L.S.*, *M.S.*, *D.S.*) of same basal sclerites as in *Diamanus*. Crescent sclerite (*C.S.*) and ventral intramural rod (*I.R.*) well developed. Penis rods (*P.R.*) long but uncoiled. The third apodemal rod arising from angle of ninth sternum; not aedeagal in origin.

Significant characters in this species are the following: Presence of apical appendage and proximal spur. Narrow accessory lateral lobes. Well-developed lateral lobes that are independent of wall of aedeagal pouch and that extend to apex of median dorsal lobe. Conspicuous basal wall of aedeagal pouch arising at level of proximal spur. Very long crochets extending far distad of endchamber. Sclerotized inner tube with complicated armature and apex. A long sclerotized band of inner tube and extra-aedeagal semimembranous tube present. Penis rods not coiled. Aedeagal apodemal rod absent. The affinities with *Ceratophyllus* s. lat. are obvious.

Genus **LEPTOPSYLLA** Jordan and Rothschild

Leptopsylla Jordan and Rothschild, Nov. Zool., **18**, p. 85, 1911.

Genotype: *Pulex segnis* Schönherr 1811 (through synonymy;=*Pulex musculi* Dugés 1832).

Leptopsylla segnis Schönherr is supposed to be a characteristic parasite of *Mus musculus* Linnaeus (the house mouse) in the Old World. The species has a wide but scattered distribution in the United States and Mexico, usually in coastal areas, and usually with *Rattus* or *Mus* as a host (actually *Mus* is seldom parasitized with fleas). It undoubtedly occurs in Central America. The species is usually placed in the family Hystrichopsyllidae, but its aedeagus, in my opinion, is of a ceratophyllid type.

Aedeagal apodeme (pl. 51, fig. 1, *AE.A.*) long, the portion cephalad of the apodemal strut about twice as long as the distance from the strut to the apex of the median dorsal lobe. Apical appendage absent. Proximal spur well developed. Base of aedeagal pouch wall (*P.W.*) arising at level of proximal spur. Lateral lobes (*L.L.*) arising somewhat distad of base of aedeagal pouch, markedly convex and extending to near dorsal margin of endchamber. Median dorsal lobe (*M.D.L.*) convex, apically broad and with margin somewhat irregular; cavity with a pair of apical, subventral, somewhat elongate sclerites (*A.M.S.*), suggesting the apical sclerites of the median dorsal lobes of certain other genera. These sclerites may be mesal extensions of the lateral plates of the aedeagal apodeme. Cavity of median dorsal lobe also with a single stout, dorsal, more proximal sclerite of unknown homology. This sclerite may be an extension of the middle plate of the aedeagal apodeme rather than an arm of the inner tube. Crochets (*CR.*) well articulated, extremely large, extending far distad of apex of endchamber; base broad and narrow; dorsal margin deeply convex subproximally; apically convex; ventral margin almost shallowly biconcave. Sclerotized sheath of inner tube short, subvertical. Armature of sclerotized sheath of inner tube (*A.I.T.*) reduced to lateral rounded thickenings. Apex of sclerotic inner tube (*A.S.I.*) truncate, somewhat expanded. Penis rods uncoiled. Aedeagal apodemal rod absent. Third apodemal rod arising from angle of ninth sternum.

The following characters found in *L. segnis* are typical of ceratophyllid fleas: The third apodemal rod arising from the ninth sternum. The very large movable crochets extending far apicad of the endchamber. The relatively short endchamber. The large convex lateral lobes that are open ventrally. The short vertical sclerotic inner tube with an expanded apex.

Genus **POLYGENIS** Jordan

Polygenis Jordan, Nov. Zool., **41**, p. 444, 1939.

Genotype: *Pulex roberti* Rothschild.

Four species of *Polygenis* are known to occur in Central America or Mexico, including *Polygenis adocetus* sp. nov. Ewing and Fox (1943) consider *Polygenis* as a subgenus of *Rhopalopsyllus* Baker 1905, but I agree with Jordan as to its generic status. Jordan, in the original diagnosis, presented an excellent discussion of the aedeagus of *Polygenis* and its allies. For purposes of uniformity, and because certain structures were not named by Jordan, the nomenclature used here is much the same as that in the other sections of this paper. It would otherwise be difficult to homologize the parts. However, certain of Jordan's

terms have been adopted, and other terms used by him are noted in the description of *adocetus*. Reference should also be made to Jordan's fine figures.

The aedeagus of *Polygenis*, like that of *Rhopalopsyllus* and its other allies, is remarkable in several respects, especially in that the sclerotic inner tube is elongate and consists of two distinct sclerites (pl. 38, fig. 6, *I.T.-A.* and *I.T.-B.*) and in that the penis rods (*P.R.*) are mainly intra-aedeagal. Lateral plates of apodeme fused ventrally and apically, forming heel (*H.*). Median dorsal lobes enclosed by dorso-apical flaps (*H.F.*) suggesting a cleft hood (pl. 39, fig. 1). Lateral lobes (*L.L.*) very long, extending from heel to apex of median dorsal lobe. Crochets (*CR.*) relatively short, less than half of diameter of aedeagus. Spiculose curved processes associated with crochets are here designated crochet processes (*CR.P.*). Armature of inner tube undeveloped. Penis rods (*P.R.*) entering aedeagus through a dilated vesicle (*V.*) and then looping under hood folds. Endchamber with an additional conspicuous sclerotized tube here called the pseudotube (*PS.T.*). Lateral sclerites, often spindle-shaped, and designated the side-piece, arising on each side near vesicle.

The following are important features to note in *Polygenis:* the heel, the elongate inner tube, the internal looped penis rods, the hood flaps, the pseudotube, the short crochets, the crochet processes, the long lateral lobes and the side-pieces.

In *Rhopalopsyllus* Baker (s. str.), the aedeagus is fundamentally like that of *Polygenis*, but, as Jordan points out, the apical segment of the sclerotized inner tube is shorter. Other differences cannot be stated because material was not available for study.

It is obvious that *Polygenis*, like other rhopalopsyllids, has an aedeagus of a remarkably different type from that of the genera already discussed. However, the aedeagus in several respects recalls that of the pulicid fleas. In these, too, the sclerotic inner tube is somewhat elongate and of two sclerites; the sclerotic inner tube has little specialized armature; the crochets are short and do not extend far distad of the endchamber; and there is a well-developed vesicle. The side-pieces suggest the spindle-shaped armature of the sclerotic inner tube of *Xenopsylla*, although they are in a different position. If what I have called the lateral lobes in *Polygenis* are in reality broadened and lengthened sides of the aedeagal pouch wall, then the crochet processes suggest the lateral lobes of *Pulex* in position and structure. It is interesting to note that while Ewing and Fox consider *Rhopalopsyllus* (*Polygenis*) to belong to the family Ceratophyllidae ("Dolichopsyllidae"), they point out that "in the characters of the head, thorax and tarsi the Rhopalopsyllinae show relationships with the Pulicidae." In Central and South America the rhopalopsylline fleas to a great extent replace the ceratophylline fleas on rodents. These fleas are usually put in the same family, but the significant differences in the aedeagi should be noted. For example, the apodemal rod is missing in *Polygenis*. The crochets are much reduced, instead of being well articulated, large and extending apicad of the endchamber. The sclerotic inner tube is neither short nor with modified armature. Nevertheless, there are other, non-aedeagal characters, beyond the scope of this work, that indicate definite affinities with the ceratophylline fleas. Jordan (1942, p. 9) considers *Rhopalopsyllus* (s. lat.) to constitute a tribe in the subfamily Rhopalopsyllinae of the family Ceratophyllidae. The subfamily, as he aptly

states, "takes an intermediate position between the Pulicidae and the more typical subfamilies of Ceratophyllidae."

The Aedeagus of Ceratophyllid Genera

Certain generalizations can be made about the aedeagus of the genera of Ceratophyllidae studied: Aedeagal pouch relatively short and its extent usually marked by the proximal spur. Latero-ventral margins of pouch sometimes sclerotized. Endchamber covered by the long lateral lobes, which are usually convex and extend from near pouch wall to near apex of median dorsal lobe. Lateral lobes variable in shape, at times fused with wall of aedeagal pouch or reduced. Crochets very large, extending distad of endchamber and with articulation permitting much freedom of movement. Median dorsal lobe often single and simple, but at times highly modified. Sclerotic inner tube short, usually vertical, with lateral and/or apical armature usually specialized. Third apodemal rod arising from angle of ninth sternum, not aedeagal in origin. *Leptopsylla* has an aedeagus of this type and, as stated above, is considered by me to belong to this family rather than to the Hystrichopsyllidae.

Genera such as *Polygenis* are quite distinct from other ceratophyllid genera with respect to the morphology of the aedeagus. The intra-aedeagal penis rods, the hood flaps, the vesicle, the elongate sclerotic inner tube of two sclerites, the heel and the crochet processes are all distinctive. The modifications of the aedeagus support the contention of most workers that *Rhopalopsyllus* (s. lat.) and its allies should be placed in a separate subfamily.

Family ISCHNOPSYLLIDAE

Genus **MYODOPSYLLA** Jordan and Rothschild

Myodopsylla Jordan and Rothschild, Nov. Zool., **18**, p. 88, 1911.

Genotype: *Ceratopsylla insignis* Rothschild 1903.

In the area under consideration, this genus is represented by *M. collinsi* Kohls 1937 (=*M. diasi* Costa Lima 1938), a species widely distributed in the southwestern United States and Mexico. The following description is based upon cleared specimens of this species.

Aedeagal apodeme (pl. 54, fig. 2, *AE.A.*) long and narrow and inclined dorsad, cephalad of apodemal strut. Apodeme cephalad of apodemal strut more than seven times as long as broad at maximum. Portion of aedeagus distad of apodemal strut less than one-third of length of portion proximad. Apical appendage absent. Proximal spur (*P.S.*) well developed. Lateral plates (*L.PT.*) of apodeme extended to apex of median dorsal lobe. Median dorsal lobe (*M.D.L.*) slightly convex, long, weakly sclerotized. On each side with a prominent acuminate lateral projection (*P.W.*) which apparently is the wall of the aedeagal pouch modified in a manner suggesting *Orchopeas*. Lateral lobes (*L.L.*) well developed, curving dorsad and extending apicad of inner tube; apical margin concave. Crochets (*CR.*) very broad at base and produced into two narrow arms; dorsal arm longer, convex, and with an apical acuminate process suggesting a pointing finger; ventral arm more angulate and with about five short finger-like apical processes. Sclerotized inner tube (*S.I.T.*) relatively simple,

short, narrow and unarmed apically. Sclerotized sheath of inner tube with specialized armature (*A.I.T.*) at most developed as a dorsal subglobose sclerotization. A pair of somewhat crescentic sclerites (*A.S.T.*) dorsad and apicad of the inner tube, the sclerites suggesting the apical sclerites of the inner tube of *Stenoponia* rather than the apical sclerites of the medio-dorsal lobe of certain other species. Apodemal strut consisting of a latero-ventral curved lobe (*L.S.*) and dorsal irregular thickenings. Crescent sclerite well developed. Dorsal intramural rod (*D.I.R.*) usually visible even in cleared specimens, ventral intramural rod (*I.R.*) well developed. Penis rods (*P.R.*) long, but not making a complete loop. Third aedeagal rod arising from angle of ninth sternum.

The following are important features in the genus: Absence of apical appendage. Development of proximal spur. Straight extensions of lateral plate of aedeagus. Simple median dorsal lobe. Paired apical sclerites of inner tube. Very well-developed, large bifid crochets. Sclerotized inner tube simple. Lateral acuminate projections representing aedeagal pouch wall. Penis rods not coiled. Absence of true aedeagal apodemal rod. Many of these characters are suggestive of the ceratophyllids, as will be shown.

Genus **STERNOPSYLLA** Jordan and Rothschild

Sternopsylla Jordan and Rothschild, Ectoparasites, **1**, p. 158, 1921.

Genotype: *Ischnopsyllus texanus* C. Fox 1914.

S. texana (C. Fox 1914) occurs in the southwestern United States and in Mexico. Records are at hand from Michoacán and Nuevo Leon, Mexico.

Aedeagal apodeme (pl. 54, fig. 3, *AE.A.*) relatively very broad, the portion cephalad of apodemal strut somewhat less than three times as long as broad at maximum. Distance from base of apodemal strut to apex of crochet less than half the distance from strut to apex of apodeme. Apical appendage absent. Proximal spur (*P.S.*) well developed. Lateral plates (*L.PT.*) of apodeme extending distad, medially convex and then continuing as lobes which almost reach apex of median dorsal lobe. Median dorsal lobe (*M.D.L.*) long, strongly convex apically and on each side bearing an apical sclerite (*A.M.S.*). Aedeagus on each side with three remarkable elongate lateral sclerites: (1) the primary lateral sclerite (*P.L.S.*), which arises at base of apodemal strut and which is sinuate, acuminate and extends to near apex of lateral apodemal plate; (2) a secondary lateral sclerite (*S.L.S.*), which is similar in shape and length, but which arises more ventrad; and (3) a sclerite arising from the circular base of the second, and which seems to be the lateral lobe (*L.L.*) but is quite short, extending only to base of sclerotic inner tube. Crochets (*CR.*) very broad and somewhat bilobed at base, broadly subtriangular, but with dorsal margin somewhat concave and apex subacuminate. Sclerotized inner tube (*S.I.T.*) very short, simple, unarmed except for stout subdorsal sclerotization (*A.I.T.*). Apodemal strut with a typical latero-ventral curved sclerite (*L.S.*) ventrad to an irregular dorsal sclerite. Crescent sclerite (*C.S.*) long and flat. Ventral intramural rod (*I.R.*) well developed. Penis rods (*P.R.*) uncoiled. Third apodemal rod arising from angle of ninth sternum.

The following characters are worthy of note: Relatively great breadth of apodeme. Absence of apical appendage. Presence of proximal spur. Arched extensions of lateral apodemal plates. Simple median dorsal lobe with apical sclerites. Very well-developed, large crochets. Simple inner tube with unspecialized armature. Three pairs of lateral narrow projections, the ventralmost of which seems to be the lateral lobes. Penis rods uncoiled. Absence of true

aedeagal apodemal rod (the third rod arises from the ninth sternum). Most of these characters are shared with *Myodopsylla collinsi*.

The Aedeagus of Ischnopsyllid Genera

The two bat fleas discussed have a type of aedeagus suggestive of that of the Ceratophyllidae. The proximal spur is well sclerotized. The crochets are very large, extending distad of the endchamber and freely movable. The third apodemal rod arises from the angle of the ninth sternum instead of the aedeagus.

Family PULICIDAE

Genus **XENOPSYLLA** Glinkiewicz

Xenopsylla Glinkiewicz, Sitzber. Akad. Wiss. Wien, **116**, p. 386, 1907.

Genotype: *Pulex cheopis* Rothschild 1903 (through synonymy;=*Xenopsylla pachyuromydis* Glinkiewicz 1907).

The genus *Xenopsylla* is represented in the New World by the introduced species, *X. cheopis*, the classical vector of plague. This species has a wide but scattered distribution in North America and Central America. The typical host is *Rattus*.

Aedeagal apodeme (pl. 53, fig. 1, *AE.A.*) about as long as aedeagus proper; lateral plates weakly sclerotized and difficult to see in cleared specimens. Apical appendage and proximal spur absent. Aedeagus proper broad at base, neck therefore absent. Aedeagus with strongly convex extensions dorsad of apodemal strut on each side serving as strengthening ribs (*RB.*), the ribs extending ventro-laterad. Basal wall of aedeagal pouch (*PW.*) at times visible as a vertical line crossing apodemal strut. Endchamber very long; portion of aedeagus apicad of base of apodemal strut subequal to length proximad of strut. Floor of aedeagus broad, somewhat thickened at latero-ventral margins, but resulting runners obscured by the more lateral and more sclerotized, slightly curved pseudocrochets (*PS.C.*). Median dorsal lobe (*M.D.L.*) short, extending only as far distad as articulation of sclerites of inner tube. Apical portion of aedeagus covered by the enlarged subtruncate hood-like lateral lobes (*L.L.*), which extend dorsad and cephalad to near margin of median dorsal lobe. True crochets apparently absent. Armature of sclerotized sheath of inner tube (*A.I.T.*) consisting of lateral fusiform but twisted or curved sclerites usually near level of apex of pseudocrochets. Sclerotized inner tube (*S.I.T.*) horizontal, long, more than half of length of aedeagal apodeme, fairly simple, consisting of two sclerites, the proximal broader, the apical rapidly narrowing. Apical sclerites of inner tube absent. Extending distad of the apex of the median dorsal lobe is an elongate sclerite (*D.I.T.*) apparently associated with the inner tube, and probably homologous with the dorsal arm of the inner tube of *Ctenocephalides*. This arm in *Xenopsylla* is even more readily separable from the inner tube than in *Ctenocephalides*, and in other species of *Xenopsylla* the articulation between the inner tube and the arm seems even less apparent. Apodemal strut consisting of the typical curved latero-ventral sclerite (*L.S.*), a more dorsal, somewhat irregular mesal sclerite (*M.S.*) and an acuminate dorsal sclerite (*D.S.*). Crescent sclerite (*C.S.*) with crescent long and narrow, scarcely curved. Penis rods (*P.R.*) well curved over apodeme, but not coiled; cephalic portions broad, especially in more dorsal rod. Ventral intramural rod of endophallus (*I.R.*) well developed. Ventral intramural rod and certain elements of penis rods enter a subspherical sclerotized lobe, the vesicle (*V.*), associated with the inner tube; vesicle dorsally appearing spiculose or striate. Third apodemal rod apparently arising from aedeagal pouch,

and hence an aedeagal apodemal rod (*A.A.R.*); there seem to be elements from the mesal margins of the ninth sternum associated with this apodemal rod, but the rod does not arise from the angle of the ninth sternum.

The following are important features of the aedeagus of this genus: Absence of apical appendage and proximal spur. Presence of dorsal strengthening processes known as ribs. Broad floor of endchamber. Reduction of median dorsal lobe. Absence of true crochets. Development of dorsal arm of inner tube; sclerotized inner tube otherwise fairly simple, horizontal and long. Presence of aedeagal apodemal rod, but with indications of association with mesal portion of ninth sternum. Aedeagal pouch wall arising almost apicad of aedeagal strut. Vesicle at apex of ventral intramural rod very well developed. Penis rods proximally dilated.

Genus **CTENOCEPHALIDES** Stiles and Collins

Ctenocephalides Stiles and Collins, Repts. U. S. Pub. Health Serv., **45**, p. 1308, 1930.

Genotype: *Pulex canis* Curtis 1826.

The dog flea, *C. canis*, and the cat flea, *C. felis* (Bouché 1835), are virtually cosmopolitan and are known from many hosts (mainly carnivores), including man and opossums. Sharif, in 1945, published an exhaustive and excellently illustrated paper on the aedeagus of *felis*. His detailed nomenclature has not been adopted in this paper to avoid confusion in homologizing parts of the aedeagus. Thus, he interprets the aedeagus as being, in the main, extensions from the ninth and tenth sterna. The third apodemal rod, the crochets, and the apico-ventral portion of the aedeagus are stated to be parts of the genital ninth sternum. It is agreed that the third apodemal rod has (in *Ctenocephalides*) some sclerotic connective strands with the ninth sternum, but it is apparently more associated with the wall of the aedeagal pouch. In the hystrichopsyllid genera studied, there is nothing to indicate to me that the third apodemal rod is part of the ninth sternum. In the ceratophyllid genera studied, the third apodemal rod is entirely removed from the aedeagus proper and arises from the angle of the ninth sternum, a fact lending support to Sharif's contention. The crochets are shown in the present study to be dorsal in some cases, not ventral as in *Ctenocephalides*. To refer to them by Sharif's terminology would be confusing. It is beyond the scope of this paper to determine the origin of the structures of the aedeagus. Thorough study of the embryology, histology and larval morphology of the many genera of fleas cited would be a prerequisite. For these reasons, in considering the aedeagus of *Ctenocephalides*, the terminology used is that found in other sections of this work, and is based mainly upon the studies of Snodgrass. The use of a standardized nomenclature is necessary in demonstrating the taxonomic value of the aedeagal structures. The terminology used, therefore, should not be construed as an adverse criticism of Sharif's distinctive contribution.

The following description is based upon a study of both dissected and cleared specimens of *C. canis*.

Aedeagal apodeme consisting of the typical three plates. Lateral plates (pl. 53, fig. 2, *L.PT.*) with a conspicuous, sclerotized straight midrib, but the margins of the plates difficult

to see in cleared specimens. Middle plate (*MI.P.*) narrow, distally expanded, well sclerotized. Apical appendage, proximal spur and aedeagal neck absent. Dorsal aedeagal ribs (*RB.*) convex as in *Xenopsylla*. Floor of aedeagus broad, somewhat thickened at latero-ventral margins, forming runners (*RN.*). Apical portion of aedeagus very long; distance from base of apodemal strut to apex of endchamber subequal to distance proximal of strut to end of apodeme. Pseudocrochets (*PS.C.*) elongate sclerites at apex of runners. Median dorsal lobe (*M.D.L.*) slender and produced dorsad apically. Lateral lobes (*L.L.*) thin but fairly broad, extending apically from pseudocrochets to near apex of median dorsal lobe. True crochets (*CR.*) reduced to small flat hooks with recurved tips, inserted at bases of pseudocrochets. Armature of sclerotized sheath of inner tube apparently undeveloped except for a small sclerotized area distad of latero-ventral lobe of apodemal strut. Sclerotized inner tube (*S.I.T.*) consisting of two horizontal sclerites, the apical one subsagittate; with a prominent dorsad directed curved extension (*D.I.T.*). The process of the inner tube, while closely adherent to the tube, readily separates under pressure, as Snodgrass points out for *felis*. Horizontal inner tube long, about two-thirds the length of the aedeagal apodeme. Apical sclerites of inner tube absent. Apodemal strut (*L.S.*, *M.S.*, *D.S.*), crescent sclerite (*C.S.*), penis rods (*P.R.*) and ventral intramural rod (*I.R.*) as in *Xenopsylla*. Vesicle (*V.*) as in *Xenopsylla*, but not as densely spiculose. The third apodemal rod arising from aedeagal pouch, and hence a true aedeagal apodemal rod (*A.A.R.*), but with some sclerotic filaments extending to mesal surface of ninth sternum.

The aedeagus of *felis* (pl. 53, fig. 3) is very much like that of *canis*, but the dorsal process of the inner tube (*D.I.T.*) is longer in proportion.

Important features of the aedeagus of *Ctenocephalides* are: Absence of apical appendage and proximal spur and of the neck. Development of dorsal strengthening processes known as ribs. Broad floor of endchamber with development of runners and pseudocrochets. Extreme length of aedeagus apicad of apodemal strut. Lateral lobes apical. Median dorsal lobe extended dorsad to cover the elongate dorsal process of inner tube. Sclerotized inner tube fairly simple, horizontal, long. Well-developed vesicle. Aedeagal apodemal rod present, but associated with mesal portion of ninth sternum. Penis rods proximally dilated.

Genus **PULEX** Linnaeus

Pulex Linnaeus, Syst. Nat., ed. **10**, p. 614, 1758.

Genotype: *Pulex irritans* Linnaeus 1758.

Two species of *Pulex* are known from the New World, *irritans* and *sinoculus* sp. nov. from Guatemala. The aedeagi of the two species are fundamentally similar, although showing specific differences previously outlined.

Aedeagal apodeme (pl. 49, fig. 4) characteristically expanded dorso-apically, thus producing a fin (*FN.*). A somewhat similar ventral expansion is at times difficult to see. Proximal spur not apparent. Median dorsal lobe (*M.D.L.*) hoodlike. Floor of aedeagus broad, laterally thickened by rodlike sclerotizations, the runners (*RN.*). The latter terminate in a distinct pair of sclerites, which superficially resemble the crochets of other species and which I have designated the pseudocrochets (*PS.C.*). Snodgrass has pointed out that the prominent single flat hook arising from the dorsal wall of the endchamber bears two muscles, and he considers this the true crochet, apparently resulting from fusion of the original pair.[1]

[1] It is interesting to note that true crochets are present (and ventral) in *Ctenocephalides* and that there is a dorsal sclerite in the area occupied by the single crochet of *Pulex*. This dorsal sclerite (pl. 53, fig. 2, *D.I.T.*) is usually considered to be an arm of the inner tube,

Lateral lobes (pl. 49, fig. 4, *L.L.*) in *Pulex* greatly reduced and apical, but ridged. Sclerotic inner tube (*S.I.T.*) horizontal, of two distinct sclerites, with greatly reduced armature. Subspherical sclerotized ventral lobe of inner tube a true vesicle (*V.*). Ventral intramural rod (*I.R.*) well developed. Penis rods (*P.R.*) coiled like a spring. Third apodemal rod (*A.A.R.*) arising from aedeagus, not from angle of ninth sternum.

Important features: fin, hoodlike median dorsal lobe, runners, pseudocrochets, broad floor of aedeagus, short apical lateral lobes, single dorsal crochet, vesicle, absence of proximal spur, and aedeagal apodemal rod.

Genus **HOPLOPSYLLUS** Baker

Hoplopsyllus Baker, Proc. U. S. Nat. Mus., **29**, p. 128, 1905.

Genotype: *Pulex anomalus* Baker 1904.

The range of the genus *Hoplopsyllus* in Central America and Mexico can only be inferred, but it is probably considerable. Jordan and Rothschild described a species from Panama. Records are at hand of what seems to be a new species taken from rabbits from El Salvador and Mexico, but description is deferred until more material becomes available. Several species are known from the United States, Canada and South America. The species from rabbits were considered by Ewing to be sufficiently distinct from *H. anomalus* (Baker 1904)—from ground squirrels—to be placed in a separate subgenus, *Euhoplopsyllus* Ewing 1940. It is interesting to compare the aedeagi of these two groups, as well as to compare them with those of other genera.

The first description following is of *Hoplopsyllus* (*H.*) *anomalus* (Baker 1904) and is based upon a study of cleared specimens.

Aedeagus (pl. 53, fig. 6) with portion proximad of apodemal strut slightly longer than apical region and more than four times as long as broad. Apical appendage and proximal spur absent. Aedeagus proper broad at base, neck therefore lacking. Dorsal strengthening rib (*RB.*) fairly straight. Aedeagal pouch apparently arising in region of apodemal strut. Endchamber very long; area apicad of base of apodemal strut subequal to length proximad of strut. Floor of aedeagus broad, somewhat thickened at latero-ventral margins, forming runners (*RN.*) which terminate in apical micromucronate sclerites, the pseudocrochets (*PS.C.*, and pl. 53, fig. 4). Median dorsal lobe (*M.D.L.*) apically produced dorsad as in other pulicid genera noted, but the cavity is not occupied by sclerites; with an apical narrow angulate sclerite—the apical medio-dorsal sclerite (*A.M.S.*)—on each side. Apical portion of aedeagus to a great extent covered by the subcordate lateral lobes (*L.L.*). Crochets (*CR.*) immediately dorsad of pseudocrochets and shaped like a meat cleaver with a shortened handle. Armature of sclerotized sheath of inner tube undeveloped. Sclerotized inner tube (*S.I.T.*) long, more than half of length of aedeagal apodeme, fairly horizontal, middle portion convex and dorsal margin here crenulate, proximal and apical portions somewhat concave; apically narrowed. Apodemal strut (*L.S.*, *M.S.*, *D.S.*), crescent sclerite (*C.S.*), penis rods (*P.R.*), and ventral intramural rod much as in *Xenopsylla*, but penis rods not as

although it is separable by pressure. In *X. cheopis* the true crochets are apparently lacking, but there is a dorsal sclerite (pl. 53, fig. 1, *D.I.T.*) suggestive of the dorsal arm of *Ctenocephalides*. It is possible that the single dorsal sclerite of *Pulex* is homologous with that of *Ctenocephalides* and *Xenopsylla* (many other aedeagal structures can be homologized in these genera, as shown elsewhere). Such a theory would not explain the muscles noted by Snodgrass nor the stoutness of the sclerite.

dilated proximally. Vesicle (*V.*) appearing as a dilated lobe at apex of ventral intramural rod. Third apodemal rod apparently arising from aedeagal pouch, and hence an aedeagal apodemal rod (*A.A.R.*). As in *Xenopsylla* and other pulicid fleas discussed, the aedeagal apodemal rod seems to have derivative connections with the mesal portion of the ninth sternum.

The aedeagus of *Hoplopsyllus* (*Euhoplopsyllus*) *affinis* (Baker 1904) is quite different, as shown in pl. 53, fig. 5.[1] The median dorsal lobe (*M.D.L.*) is produced distad, not dorsad, and apical medio-dorsal sclerites are absent. The crochets (*CR.*) are more apical in position and of a different shape. The pseudocrochets (*PS.C.*) are less sclerotized and are not mucronate. The basal wall of the aedeagal pouch arises cephalad of the apodemal strut. The apodemal strut is remarkable in that an accessory sclerite or arm (*A.S.A.*) extends far apicad of the typical sclerites of the strut; the arm elongate and arising ventrad to inner tube, dorsad to vesicle (*V.*). Sclerotized inner tube (*S.I.T.*) with dorsal margin evenly convex, not crenulate. These differences are corroborative evidence in support of Ewing's contention that *H. anomalus* should be placed in a separate subgenus.

The following characters are of importance in *Hoplopsyllus*. Absence of apical appendage and proximal spur. Broad floor of endchamber with development of pseudocrochets. Lateral lobes apical. Median dorsal lobe expanded dorsally or apically. Crochets relatively short, not projecting apicad of endchamber. Absence of dorsal arm of inner tube. Sclerotized inner tube simple, horizontal, unarmed. Aedeagal apodemal rod. Well-developed vesicle.

The Aedeagus of Pulicid Genera

The genera of Pulicidae studied have certain characteristics in common that are worthy of note. The endchamber is lengthened considerably; the distances proximad and apicad of the apodemal strut are usually subequal. The floor of the endchamber is usually broad and strengthened with thickened lateral runners. The runners terminate in distinct sclerites termed the pseudocrochets. The true crochets are reduced or absent; even when well-developed, they project only slightly from the endchamber. The lateral lobes are apical in position and are short. The proximal spur is not apparent. The apical appendage is absent. There are often dorsal curved strengthening processes called ribs. The median dorsal lobe is often expanded dorsad and frequently has subdorsal sclerites, which may or may not be associated with the inner tube.

The inner tube is horizontal, elongate, usually of two distinct sclerites, relatively unarmed, and with a distinct vesicle, which is a dilated subspherical structure ventrad to the base of the inner tube and into which enter elements of the penis rods and ventral intramural rod. The third apodemal rod is aedeagal in origin, but apparently is also associated with elements of the ninth sternum.

Family HECTOPSYLLIDAE

Genus **ECHIDNOPHAGA** Olliff

Echidnophaga Olliff, Proc. Linn. Soc. N. S. Wales, **1**, p. 172, 1886.

Genotype: *Echidnophaga ambulans* Olliff 1886.

[1] Specimens obtained through the courtesy of R. B. Eads of the Texas State Board of Health.

Echidnophaga gallinacea (Westwood 1875), the so-called sticktight flea, is very widely distributed through Central America and Mexico. The aedeagus of this species is very interesting.

Aedeagal apodeme (pl. 54, fig. 4, *AE.A.*) with dorsal margin fairly straight for most of its length; ventral margin convex; apex acuminate but short. Portion of aedeagus cephalad of apodemal strut about three times as long as broad at maximum, and only about twice as long as portion apicad of base of strut. Apical appendage and proximal spur absent. Aedeagus proper broad at base. Aedeagal pouch (*P.W.*) arising at level of apodemal strut; ventral margin extended apicad as straight fairly well-sclerotized runners (*RN.*) terminating in small subapical pseudocrochets (*PS.C.*, and pl. 54, fig. 5). Median dorsal lobe (*M.D.L.*) bifid apically, each branch acuminate. Lateral lobes (*L.L.*) subrounded or slightly sinuate, extending from pseudocrochets to near apex of median dorsal lobes. Crochets (pl. 54, fig. 5, *CR.*) dorsal in position, crescentic in shape; apically curved mesad. Sclerotized inner tube (*S.I.T.*) simple but of two sclerites; straight, horizontal, armature reduced. A pair of subquadrate sclerites (*A.S.T.*)[1] distad of apex of sclerotic inner tube. Ventral intramural rod (*I.R.*) and elements of penis rods arising from a dilated lobe, the vesicle (*V.*), ventro-apicad of apodemal strut. Apodemal strut consisting of a curved latero-ventral sclerite (*L.S.*), a more dorsal mesal lobe (*M.S.*), and a shorter dorsal lobe (*D.S.*). Crescent sclerite (*C.S.*) well developed. Penis rods (*P.R.*) uncoiled. Third apodemal rod (*A.A.R.*) arising from aedeagal pouch and hence a true aedeagal apodemal rod.

The following characteristics should be noted: Absence of apical appendage, proximal spur, and neck. Presence of dorsal crochets and of apical sclerites of inner tube. A simple, horizontal, unarmed two-segmented inner tube. Presence of runners and pseudocrochets, a well-developed vesicle, and a true aedeagal apodemal rod. Nearly every one of these characters is found in the Pulicidae studied.

Genus **TUNGA** Jarocki

Tunga Jarocki, Zoology, or Gen. Descr. Anim., p. 50, 1838.

Genotype: *Pulex penetrans* Linnaeus 1758.

Tunga penetrans is, of course, well known in many tropical areas. However, frequently only the females, because of their size and habits, are collected. Unfortunately no males of this remarkable genus were available for dissection and only a few cleared specimens were studied. The homologies of certain parts of the enormously specialized aedeagus can only be guessed at. Further study may be stimulated by a comparison of the aedeagus of this species with those previously discussed. Although unengorged *Tunga* are considered to be the smallest known fleas, the aedeagus is apparently the largest in proportion to size.

Ewing and Fox (1943, p. 121) in discussing *Tunga*, state: "Penis complicated, consisting of a basal or anterior part hinged to a distal or posterior part; anterior part composed of a dorsal, pedicellate, basal plate, arising from segments I and II of abdomen, and a ventral elbowed part attached to distal part by a strong ligament; posterior part of penis bearing

[1] Snodgrass apparently does not mention these sclerites, but they are suggestive of what I have called the apical sclerites of the inner tube in the case of *Stenoponia* and certain other genera. Snodgrass mentions a pair of small ventral lobes. It is believed that these refer to the sclerites I have termed the pseudocrochets; they have also been demonstrated in the Pulicidae studied.

distally a pair of slender, forked, almost straight parameres and a somewhat longer, unpaired, slender process."

Using the apodemal strut (pl. 54, fig. 6, *AP.S.*) as a landmark, it is possible to homologize certain parts of this highly modified aedeagus. The aedeagal apodeme (*AE.A.*) is extremely short. The great length of the aedeagus seems to be due to extreme lengthening of the inner tube (*S.I.T.*), which arises distad and below the crescent sclerite (*C.S.*) as a feebly sclerotized tube, but which becomes well sclerotized distad of its articulation. At the elbow or articulation arises a pair of elongate lateral lobes (*L.L.?*), which extend to the apex of the tube. These may be homologous with the lateral lobes of other genera, but are of a type different from the apical lobes found in *Echidnophaga* and the pulicids. A second, more mesal, pair of lobes (*M.D.L.?*), suggesting unpaired dorsal lobes, flank the distal segments of the inner tube for apical three-fourths of its length. Ventral thickenings (*PS.C.?*) suggest pseudocrochets. Penis rods cannot be seen in these cleared specimens.

The Aedeagus of Hectopsyllid Genera

The differences between the aedeagus of *Echidnophaga* and that of *Tunga* are so great that it is useless to try to make any comparative generalizations. The aedeagus of *Echidnophaga* resembles that of the Pulicidae. That of *Tunga* is extremely specialized and needs further study. It would be most instructive to compare the aedeagus of *Tunga*, as studied from preserved or fresh specimens, with those of *Hectopsylla* and other burrowing fleas.

PART III

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HOST INDEX

INDEX

Synonyms and old combinations in *italic* type; new species and subspecies and important page references in **boldfaced** type.

LIST OF ABBREVIATIONS[1]

A.A.R. Aedeagal apodemal rod.
A.B. Antepygidial bristles.
AE.A. Aedeagal apodeme.
AED. Aedeagus.
A.I.T. Armature of sheath of inner tube.
A.L.L. Accessory lateral lobe of aedeagus. Extensions of lateral plate of aedeagal apodeme.
A.M.S. Apical sclerite of median dorsal lobe of aedeagus.
AP.A. Apical appendage. Cephalic rod-like appendage of aedeagus of certain genera.
AP.R.9 Apodemal rod of ninth sternum.
AP.S. Apodemal strut.
A.S. Anal stylet.
A.S.A. Accessory sclerite of apodemal strut.
A.S.I. Apex of sclerotized inner tube.
A.SP. Accessory spur of aedeagus.
A.S.T. Apical sclerites of inner tube.
B.C. Bursa copulatrix.
B.I.T. Sclerotized narrow band of inner tube extending distad of apex of sclerotized sheath of inner tube.
CL. Clasper.
CR. Aedeagal crochets.
CR.P. Crochet processes.
C.S. Crescent sclerite. A sclerite mesad to apodemal strut and in which dorsal margin is well sclerotized and crescentic in shape.
D.A.9 Distal arm of male ninth sternum.
D.A.L. Dorsal anal lobe.
D.I.R. Dorsal intramural rod of endophallus.
D.I.T. Dorsal arm of inner tube (*Xenopsylla* and allies).
D.L. Disto-dorsal articulated lobes of aedeagus (*Strepsylla*).
D.L.P. Dorsal lobe of proctiger.
D.S. Dorsal lobe of apodemal strut.
D.S.I. Dorsal sclerotization of sheath of inner tube, as in *Ctenophthalmus*.
D.S.L. Dorsal spur of lateral plate of aedeagal apodeme (*Orchopeas*).
E.I.T. Extra-aedeagal semimembranous inner tube extending distad of sclerotized sheath of inner tube.
EPX. Epipharyngeal stiletto.
F. Movable finger of clasper.
F1. Anterior or dorsal movable finger of clasper.
F2. Posterior or ventral movable finger of clasper.
FL. Semimembranous flap on ventral margin of ninth sternum (*Strepsylla*).
FN. Fin. cephalo-dorsal expansion of aedeagal apodeme.
G. Girdle encircling aedeagal apodeme; formed by sclerotized walls of aedeagal pouch.

[1] Listed alphabetically, regardless of punctuation.

H.F. Hood flaps. Dorso-apical aedeagal flaps partially enclosing median dorsal lobe (*Polygenis* and allies).
HL. Heel, formed by ventro-apical fusion of lateral plates of aedeagal apodeme (*Polygenis* and allies).
I.M. Intersegmental membrane.
I.R. Ventral intramural rod of endophallus.
I.T.-A. Apical sclerite of sclerotic inner tube.
I.T.-B. Basal sclerite of sclerotic inner tube.
K. Keel formed by fusion of ventral walls of aedeagal pouch.
LAC. Maxillary laciniae.
L.L. Lateral lobe of aedeagus.
L.P. Labial palpi.
L.PT. Lateral plate of aedeagal apodeme.
L.S. Latero-ventral curved lobe of apodemal strut of aedeagus.
L.S.I. Lateral sclerotization of inner tube.
MB. Manubrium.
M.D.L. Median dorsal lobe of aedeagus.
MI.P. Middle plate of aedeagal apodeme.
MPM. Mesepimeron.
MPS. Mesepisternum.
M.S. Submedian mesal lobe of apodemal strut of aedeagus.
MX. Maxillary lobe.
N. Neck. Constricted portion cephalad of apodemal strut of aedeagus of certain genera.
P. Immovable process of clasper.
P1. Anterior or dorsal process of immovable clasper.
P2. Posterior or ventral process of immovable clasper.
P.A.9 Proximal arm of male ninth sternum.
P.D.L. Secondary or paradorsal lobe of aedeagus (*Kohlsia*).
P.L.S. Primary lateral sclerite of aedeagus (*Sternopsylla*).
P.M.D. Primary median dorsal lobe of aedeagus.
PR. Process of intersegmental membrane between segments eight and nine.
P.R. Penis rods.
P.S. Proximal spur of aedeagus. Marks limit of aedeagal pouch.
PS.C. Pseudo crochets. Ventro-apical sclerites, suggesting crochets.
PS.L. Pseudo-ventral lobe. A modification of median dorsal lobe (*Kohlsia*).
PS.T. Pseudo-tube. An accessory tube superficially resembling inner tube (*Polygenis* and allies).
P.W. Wall of aedeagal pouch.
RB. Rib. A dorsal strengthening sclerite in the aedeagus of *Ctenocephalides* and allies.
RN. Runners. Lateral thickenings of floors of aedeagus.
S. Sail. Dorsally arched middle plate, as in *Ctenophthalmus*.
S.D.L. Subapical dorsal lobes of aedeagus.
S.I.T. Sclerotic inner tube.
S.L.S. Secondary lateral sclerite of aedeagus (*Sternopsylla*).
SP. Spermatheca.
T.AP.8 Tergal apodeme of eighth segment.
T.AP.9 Ventral margin of apodeme of ninth tergum.
V. Vesicle at apex of ventral intramural rod of aedeagus.
V.A.L. Ventral anal lobe.
V.L.P. Ventral lobe of proctiger.
V.S.I. Ventral sclerotization of sheath of inner tube as in *Ctenophthalmus*.

X.G. The so-called X-gland of Wagner.
7 S. Seventh sternum.
8 S. Eighth sternum.
8 T. Eighth tergum.
9 T. Ninth tergum.